Engineering News-Record

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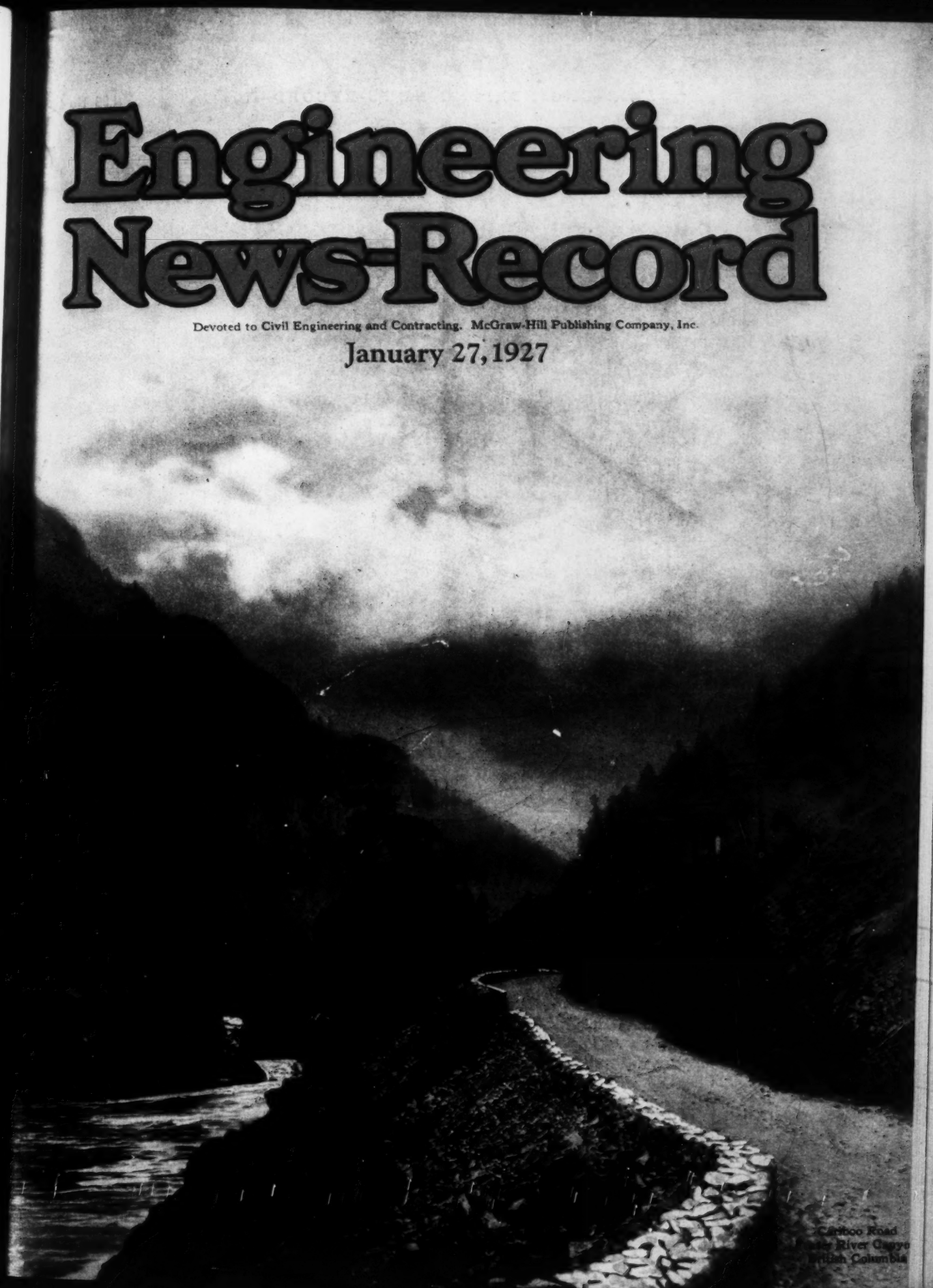

Cariboo Road
Fraser River Canyon
British Columbia

A Consolidation of Engineering News, Engineering Record and The Contractor

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

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FRANK C. WIGHT
Editor

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Study of Hurricane Action

VALUABLE results promise to flow out of the study of hurricane effects now being carried on by a committee of the American Society of Civil Engineers. In its progress report at the annual meeting, last week, the committee outlined the major points of its study and reported that it already has many of the data from which it will ultimately draw its conclusions. It is gratifying that this important movement is making progress. It gives assurance that the structural experiences of Florida's visitation of last September will be crystallized out into definite form for the guidance of future building practice. In particular, it is likely that a better understanding of the manner in which high city buildings resist wind attack will be obtained. At present, structural practice is based on certain views of this action which are known to be satisfactory under ordinary conditions, but are subject to serious doubts in application to extreme conditions. As lateral strength is an increasingly important problem with the growth of building heights and the increase in variety of building form and service, the future progress of the building art is closely concerned with the clearing up of these doubts. One of the questions at issue is whether only the strength of the structural elements is involved, or whether, on the contrary, their rigidity also plays a part. Rigidity of frame and walls has heretofore received only minor attention in the structural engineering of buildings, but in view of the action of the Florida hurricane it properly is made one of the leading points in the committee's work. Unfortunately there are few or no test data on the rigidity of the various forms of wall construction, and in their absence the interaction of frame and walls is not susceptible of quantitative estimate. The committee has already foreseen the desirability of tests to clear up this point and it is hoped will carry them out. If the committee achieves the aim of providing better knowledge of wind pressures and a clearer understanding of structural resistance to wind, it will perform a service of lasting value.

Publicity for the Road Builders' Financing

IN the news pages of this issue there is presented an abstract of the report of the fiscal committee which was instructed to analyze the finances of the American Road Builders Association and to recommend a budget for the coming year. The report is only a report, and will not become effective until adopted by the board of the association some months hence, but it is a step in the right direction. The association is in almost a unique position among technical societies in that it has revenues not only from its membership dues but also from the business of promoting and running an exhibition, which draws into its fiscal plan the possibilities of profit with all the controversy thus entailed. There has been much of this controversy in the past, due, we believe, mostly to a lack of understanding of just what were the fiscal operations of the association. For this the association is itself to blame. It is not a private institution, but a technical society, unfortunately perhaps engaged in business. In the past it has been led too much by the policy of the business man to keep the details of his business to himself. It must change this. It must court publicity, not only of its technical proceedings but of its financial operations. Toward that end, the report of the fiscal committee is a proper step but if the board would gain the full confidence of the members, and of the supporters of the Road Show, it must, when it comes to adopting a budget, go even further than did the committee and present a full report of the operations of the show. In that way only can it assure the members—who sometimes hear vague rumors of mismanagement and lacking information are inclined to accept them as true—that the direction is both careful and farseeing.

Self Protection

NEWSPAPERS throughout the country gave a great deal of space last week to a warning by S. W. Straus, head of the great investment house that bears his name, that "the saturation point in building construction had been reached." His firm advises that no more new office buildings, hotels, apartment houses and apartment hotels be started for six months or a year. This is interesting, not because the warning is new, but because it has created so much stir and has been so misinterpreted. This journal has been pointing out the situation here pictured for over a year. It has called attention to the fact that our large cities are being fast overbuilt with certain types of buildings—mostly those for group housing and for entertainment—and that danger lay ahead in the unsoundness of the financing of most of these structures. In short, it is speculative building that has been run to death, in part by sound financial houses but mostly by the camp-followers who were looking for easy profit and were trading on the easy salability of building securities to the general public. The danger is two-fold, first that the investors who have rushed into this type of security will be penalized, and second, that the reaction from the over-extension of this special field will improperly affect the development of needed construction. The first danger can hardly be avoided; there is no way apparently to force the buyer to beware. But the second can be avoided if it be clearly understood that Mr. Straus—and many others in his same line of business—consider all construction to be what is really a very limited part of construction and that when there are winds blowing thereabouts they issue general storm warnings. It is decidedly foresighted for anyone who has any money tied up in speculative or investment buildings of large proportions to try to keep others from flooding the market. But those concerned with

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the great body of construction outside of hotels, offices and apartments need not be stampeded by this gesture toward self-protection.

Coagulation On a Large Scale

THE half billion gallons daily of water now being treated with a coagulant just before it passes from the Catskill Aqueduct into the Kensico reservoir of the water supply of New York City is by far the largest-scale example of water coagulation thus far presented to the world. It illustrates not only the readiness of the engineer to deal with vast quantities or forces, as the case may be, but also his foresightedness in planning for emergencies. Means for coagulating this mountain water supply to cope with high turbidity were provided years ago when the Catskill works were designed and built. The works were put in use in 1917 but ten years passed before coagulation was first used. When needed it was ready, as was detailed in our issue of Jan. 20, p. 112. Chlorination of this great water supply has been practiced constantly for years. This and the temporary coagulation afford examples of the "water refining" of which the late Dr. William T. Sedgwick spoke eloquently some years ago.

Modern Mountain Roads

SCENIC splendor is normally the aspect of the mountain or canyon highway which first impresses. This aspect alone is emphasized by the views in this issue of the Fraser River and, in the issue of Jan. 6 of the Cameron Pass highway. A more significant picture is presented by the maps. These show how the new roads join across mountains great regions of potentially large trade intercourse. The text tells the fact of greater significance than visions of blue mountain distances, that in climbing over mountains these roads have grades which only once or twice are as steep as ten per cent and are generally flatter than six per cent. These are only two of the trans-mountain roads which the mountain territories of the Far West have been building and in all of them, while the scenic value has been fully appraised, the fact that they are tools of transportation has been first recognized in wide traffic-ways and flat grades and curves and in sound structure and construction.

Sewage Research in the West

STATE research in sewage treatment in the United States has been confined to a few commonwealths, located mostly on the Atlantic Seaboard. This is not surprising for there population and industry have been densest and many of the rivers have been too small to dispose of municipal sewage and industrial wastes without nuisance. Concentration of population and industry in other parts of the country and a growing demand for preserving natural water supplies from gross pollution are leading some of our Middle and Far Western states to study sewage treatment problems as never before. A current example is afforded by California, where nuisances from sewage and industrial wastes are on the increase and where the character of the sewage and wastes gives rise, in some cases, not only to troublesome pollution but also to serious damage to the masonry and metal of sewage and sewage treatment systems. In view of these conditions a bill authorizing the State Board of Health of California to engage in sewage and trade wastes research has been drawn for legislative action, as outlined on p. 170 of this issue. Favorable action on the bill would result in benefit to California and in lesser degree to the other states of the Union. Some of these states, particularly Massachusetts for forty years past, have been amassing experimental data which have been widely used throughout the country and the world. It is time for other states to do their share for the country's good while addressing themselves directly to their own problems.

Bring in the Army Later

THE plan for a department of public works by the committee by the Engineering Council, outlined on another page, is by far the most satisfactory analysis of the departmental reorganization scheme that has been made in years. By this we do not mean to endorse all of its details, or to suggest that it should be passed by Congress exactly in the form submitted. Any such radical departure from long accepted organization must have the benefit of open discussion and that by those affected as well as by disinterested experts such as made up the committee. But the problem of reorganization has been attacked on a much sounder basic plan than ever before. The major question about the scheme is whether it would be better, assuming the essential desirability of the project, to inaugurate it in toto or whether it might not be the slow development that has appeared of late to be the only practicable way the reform could be accomplished.

This is particularly true in the radical suggestions of the reorganization of the river and harbor work, admitted by all to be the most serious impediment to the adoption of the scheme. This journal for years has argued that the Corps of Engineers should be reformed and that the river and harbor work should be reformed, the first by some scheme whereby the officers would gain wider engineering experience, the second by some scheme whereby the vast body of civilian engineering talent engaged therein could rise above enforced mediocrity. But we have also always recognized that there is such a thing as esprit de corps, that the army, of its nature, is different from a civilian body, that for the emergency the army may well need—and the country need with it—the kind of morale that comes only with a background of responsibility as a unit. That responsibility and esprit de corps the Army Engineers have as a result of their river and harbor assignment. Doubtless they would lose it were they to be scattered, as individuals, through a civilian bureau. But they would by the latter process become better engineers than they are now, more rounded, more trained in the exact kind of engineering problems they must encounter when they go to war. The balance is hard to draw, especially as both civilian and army engineer in government service have inherited prejudices that will make amalgamation difficult.

We believe that the proposed Department will have a better chance of being formed and if that takes place a better chance for successful early life were it not complicated by this military-civilian difficulty at the very beginning. Once organized and operating successfully, once its basic theory has been confirmed the chances of amalagamation of the military branch will be much brighter and the success of that amalgamation more assured.

What Kind of Education?

AFTER listening to any discussion of engineering education in which the practising engineer or constructor participates one must have great sympathy for the engineering educator. Years ago the pedagogue laid down the principles and methods of engineering instruction and the practitioner accepted them. It was not considered that the experience of the person who had gone through the régime was of any value nor was there much effort to check the kind of college training with the results obtained. If the product of the engineering school was not a success the fault was assumed to be with the material and not the method. Times have changed this. Today the avowed purpose of the engineering educator is to test out his method by the result, to analyze his product and particularly to get that product, the practising engineer, to examine his practice and to recall his training so as to see if by chance there is any relation between the two which may be profitably changed or retained.

With the best intentions in the world both by the educator and the educated, we do not seem to be getting ahead very fast in this process of self analysis. The engineer and the constructor more than ever before are thinking about the young men who are coming along to take their places. They want to help these young men; they want to help themselves by providing better human material to take part of their burden, they think with the accustomed dissatisfaction of age that youth is not measuring up to its requirements. But in spite of all this, whenever they attempt to formulate this complaint or to lead the educator along the path he should pursue they become tongue-tied with generalities and overborne with detail.

The meeting of the Construction Division of the American Society of Civil Engineers last week was no exception to this rule. With commendable enterprise this division, comprising those engineers whose major interest is the field operations of the profession, had a symposium on the needs of engineering education as it applied to construction. Professor and contractor came together to try to find a common ground between those who demand and those who supply the engineering talent that is to be directed toward the building of structures. Of course the time was short and the discussion necessarily limited but one came away from the discussion with the impression that if the constructor could not tell what he wanted in the way of inert materials and machines more precisely than he can detail his demand for human material that the stuff he purchased would be pretty poorly fitted to its purpose.

The constructors, in this discussion, and engineers in all similar discussions, are insistent on a man "trained in the fundamentals," on getting men who are self-reliant, persevering, confident, trained in economics and of a fair degree of culture. In other words, they want the kind of young man every father might well hope his son would be, whether that son is to be a minister or a bond salesman. They are demanding qualities of character—just as did those who reported a decade ago to Professor Mann and led that investigator to conclude that the prime requisites of a good engineer were qualities of the spirit which were by no means the peculiar necessity of the engineer.

The educator on the other hand is expected to take these generalities and to translate them into applied curricula. He is expected to take the grist that comes to him, or the selected grain that some now attempt to get, and to create therefrom the finished flour satisfactory to the user. And he has the greatest difficulty in finding out just what that demand is, and certainly very little aid from the user as to the machinery which will produce it.

To be specific, there is hardly an engineer who does not insist that the student needs a thorough grounding in the basic sciences of physics, mathematics and mechanics, and that the special applications of those sciences can well be left to the post-collegiate training. But few of these engineers really mean that. They would not want to take in as a recruit engineer one who had studied these sciences as mental exercises, remote from their application. They visualize this basic training as an applied science, they see the mechanics tied up to stresses in frames, they connect the theories of fluids with the actual behavior of water in a penstock, they value differential equations only as they permit the solution of a practical problem. Freely they would admit that these fundamentals must be taught in their applications but they find it impossible to delimit the twilight zone which lies between the desired teaching of a fundamental in its application and the condemned applying of this fundamental to a specific problem. How to delimit this zone is the worry of the educator, and the practitioner should remember that the educator is getting a lot of advice as to what he should do but very little on how to do it.

What engineers who are demanding reforms in training should remember is that after all there is such a thing as an engineering method which is distinct from the legal method and even from the scientific method. It is not altogether tangible, nor explainable, but as nearly as it can be defined it is science combined with utility. The method has developed over the centuries, but it has developed most rapidly in the past half-century. It has been highly successful in many ways; it has transformed the world. But it has drawn in its train certain defects—defects of narrowness, of intolerance, of short vision in public affairs, of too great insistence in the material at the expense of the human. Those shortcomings the engineer is beginning to recognize and he is turning to the educator, as the controller of the source, for remedy. But in demanding these remedies let us not make them so drastic that we kill the patient. Let us not begin to imagine that there is no such thing as an engineering training, that all we need is strong, brainy, young men, schooled in culture, impressed with basic principles, receptive of ideas. Such men are rare and they would become great engineers or great physicians or great grocery men as their fate dictated. But the run of the mill of men need something more to make them embryonic engineers, they need some sort of a specializing bending of the twig, some early impression of the engineering mode of thought and procedure. Somewhere between the purely humanistic training that, in its ideal form, lifts only the spirit and makes life more livable, and the purely scientific training that concerns itself only with the behavior of the things and forces of nature—somewhere between must the engineer's training lie. Let us not in our effort to get away from the one turn completely to the other. Let us not forget that while the engineer has his defects, they are the defects of his qualities and that it is no cure of defects to wipe out with them all of their concomitant virtues.

Building Canyon Highway in British Columbia

Highway Connection from British Columbia Highlands to Coastal Plain Is Made by Construction of Hundred-Mile Road Through Fraser River Canyon from Lytton to Rosedale

By Patrick Philip
Deputy Minister and Public Works Engineer, Province of British Columbia, Victoria, B. C.

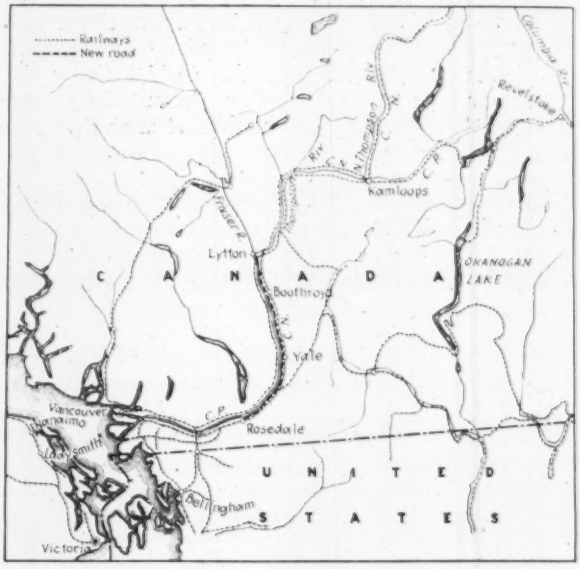
A CANYON highway of notable construction and scenic importance is nearing completion in the great gorge of the Fraser River which gives a pass through the British Columbian Rockies to the coastal plain and the city of Vancouver. This road has been constructed in the last three years partly by contract and partly by force account. From Lytton, where the Thompson River gorge enters the canyon of the Fraser, to Rosedale, where the river turns west to the coast, the length of the new highway is 93 miles. For its whole length it parallels two railways, grasping for its location what they have left of the canyon sides. The map and the views show the conditions and the highway characteristics.

The new road is not the first highway along its location. The Fraser and Thompson River valleys are the natural passes through the mountains to the coast. In the fifties they furnished a way for pack trails for the gold seekers. These trails were developed into 4-ft. mule roads. Then in 1862 a wagon road was begun and continued in sections till 1875. Then followed the extension to the coast of the Canadian Pacific Ry., following the Thompson and Fraser rivers. This construction destroyed parts of the old highway and soon it ceased to exist as a kept road. In 1910 the Canadian National Ry., coming from the east by the North Thompson and the Thompson rivers possessed itself of the opposite side of the Fraser canyon for its right-of-way. When in 1924 plans for the new highway were undertaken, the road had to be located where it could be and not encroach on the railway rights.

The old pack trails were known as the Cariboo Road and this became the name of the new highway.

Location and Design—So far as possible, the surveys followed approximately the old Cariboo Road, and a considerable proportion of the new road actually occupies very closely the original route. However, no fewer than 33 of the 45 grade crossings on the old location were eliminated, and of the remainder, five crossings are now overhead, one is a proposed undercrossing and six are grade crossings. Between the east approach to the Alexandra Bridge and Lytton, a distance of 45 miles, the location was purposely fixed to avoid crossing the Canadian National Ry. at any point. On the 14-mile portion from Yale to Alexandra Bridge at Spuzzum, there was little or no choice as to location, the existence of the Fraser River canyon and the Canadian Pacific Ry. rendering it imperative to utilize the limited areas available. With the exception of this portion where the width was made as great as was physically possible, the roadbed has a minimum width of 16 ft. with a width of at least 20 ft. on curves. Curvature was made as easy as possible and the limit is 60 ft. on interior and 100 ft. on exterior radii. A maximum grade of 8 per cent was fixed, but at Jackass Mountain where the original road grade could not, in reconstruction, be reduced, the grade averages 10 per cent for a short distance. Superelevation at sharp curves and vertical curves at quick changes of grade were generously provided.

The original location paralleled the Canadian National



CARIBOO ROAD IN BRITISH COLUMBIA

Ry. at Hell's Gate, a hazardous spot where the cliffs are unstable, and in order to avoid this menace and other undesirable features, it was necessary to run the new line at a higher elevation. To accomplish this, at two strategic points tunnels, 260 ft. and 90 ft. long on tangents, had to be constructed.

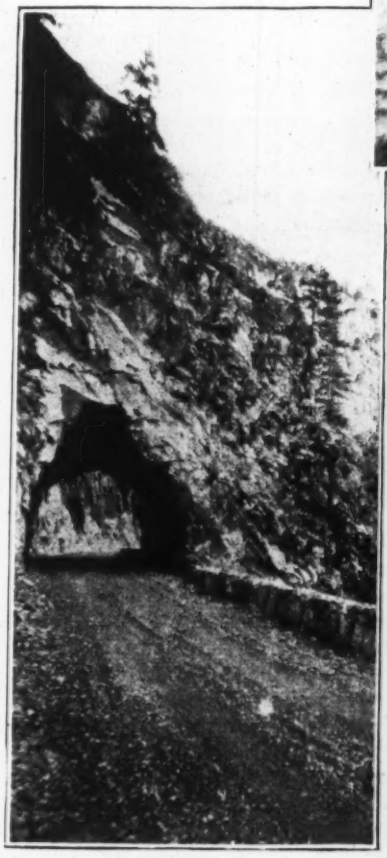
Contract Construction—Contracts were let for 35 miles between Yale and Boothroyd. The work was difficult, owing partly to the absence of even accommodation trails, and partly to the inaccessibility of the steep, rocky slopes. Packing on men's backs of anvils and other heavy tools for construction operations had to be resorted to. For the same reasons the usual methods of constructing such major works by excavators and power equipment had to be dispensed with.

Ingenious methods were adopted in handling large boulders and excavated blocks by tripods and hand cranes made on the job. Air compressors and rock drills were, of course, used in the heavy rock excavation; so precipitous were the rocky slopes in some sections, however, that the drilling and other work had to be undertaken by men suspended by ropes. The portion known as China Bar Bluffs proved exceedingly hazardous as it directly overhung the Canadian National Ry. tracks some 300 ft. below. Every yard of rock had

LOCATION ABOVE RAILWAY COMPLICATED CONSTRUCTION

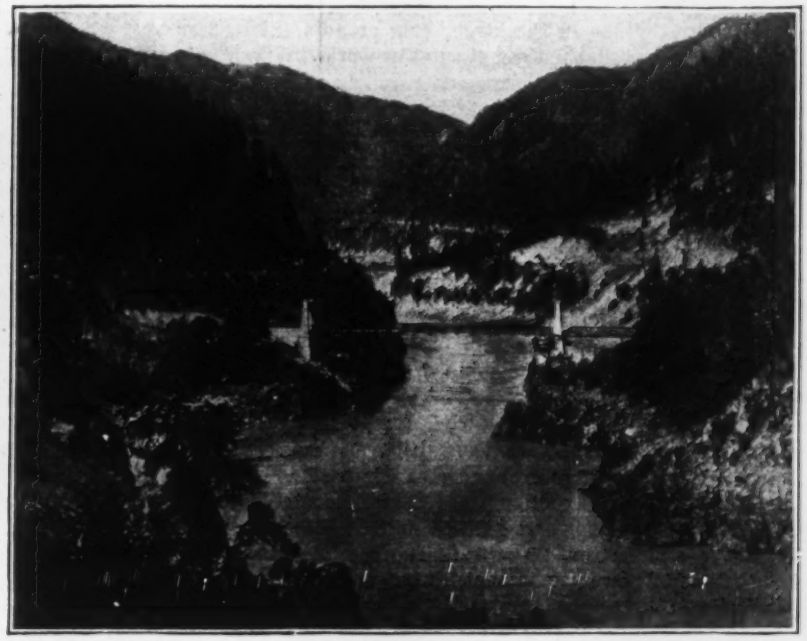
TYPICAL DRY MASONRY RETAINING WALL

(ABOVE) INTERSECTING RAVINES DEMANDED MANY BRIDGES



SOLID ROCK TUNNEL AT 1,100-FT. ELEVATION

CARIBOO HIGHWAY PARALLELS TWO TRANSCONTINENTAL RAILWAYS, ONE ON EITHER BANK OF THE RIVER (LOWER VIEW)



not only to be laboriously moved by manual methods (exclusive of rock drilling and small blasts) but had to be loaded and hauled to safe dumps away from the railway and from the Fraser River so as not to obstruct the passage of salmon to the spawning beds.

An unusual feature of construction were the two tunnels. The larger tunnel (260 ft. in length) was 27 ft. wide and 17 ft. high and since both tunnels were bored through hard rock and absolutely dry it was unnecessary to line them. The tunnel is at El. 1,100 but the highest point (1,180 ft.) on the entire road is at the summit of Jackass Mountain about 20 miles further north.

With so much rock conveniently available it was possible to construct substantial dry rock retaining walls of massive blocks, and it is interesting to note that in many places the foundation courses of such walls were laid directly on the old road formation, in some instances even on portions of the old retaining walls. The rock was also largely used in building dry parapet walls at least 18 in. thick and about 2 ft. high. Where rock was not handy, heavy log protection rails were built.

Bridges—In addition to many timber trestle bridges, there are several important framed trusses, notably those at Cisco, Stoyama and Anderson creeks. Cisco Bridge is a 150-ft. span and the other two are each 160 ft., being all of the Howe deck type and having a width of roadway of 14 ft. 8 in. Since the bridges crossed rocky canyons at an average height of 160 ft. from the bed of the creeks their erection required an abnormal amount of falsework. Excavation for foundation piers in the precipitous solid rock involved expensive and hazardous work. At Cisco the bridge material had to be hauled up the steep slopes on a specially laid narrow-gage track, but this problem and all other unique construction difficulties were satisfactorily solved, the entire work being undertaken by day labor under the supervision of the department's special bridge foreman.

Contract Surfacing—The gravel surfacing of the entire 35-mile stretch constructed by contract was undertaken as a separate contract. Several gravel and shale deposits either in the larger cuts or adjacent to the road were available throughout the work. Where necessary, the gravel was screened through a grizzly, but generally most of the surfacing material was of such a character as to permit its being deposited directly on the roadbed

By means of power shovels and large trucks it was possible to undertake a considerable yardage daily. Motor graders were ultimately employed to consolidate and shape the roadbed to an even and uniform contour. Since the major portion of the road is made up of excellent materials with a large proportion of rock, a splendid gravel surface should be obtainable once the roadbed has had the benefit of the combined settling effects of weather and wear.

Day Labor Construction—The foregoing relates wholly to the work by contract between Yale and Boothroyd, about 35 miles, but equally important construction and reconstruction was carried out by day labor between Rosedale and Yale, 35 miles, and between Boothroyd and Lytton, 23 miles. The special feature was the use of power equipment, three gas shovels and several trucks, tractors and motor graders being used. The work between Boothroyd and Lytton consisted chiefly of widening and of improving the grade and curvature of the old Cariboo Road. Where such improvements were not considered practicable, diversions were made. The material chiefly consisted of gravel with large, round boulders, slide rock and solid rock.

On account of the existence of large boulders it was not practicable to plow the gravel areas, so much of this material had to be moved by hand at a cost of about 60c. per cubic yard. On the southerly side hill approach (11 per cent grade) to Jackass Mountain a speeder gas shovel was employed handling loose rock and hardpan at a cost of under 10c. per cubic yard. Operations at the summit of Jackass Mountain (El. 1,180) were both difficult and costly. With the railway 500 or 600 ft. directly below the roadbed, heavy blasting of rock in widening the old narrow road was prohibited, and moreover every yard of rock had to be hauled away to dumps clear of the railway right-of-way. To retain the rocky slopes at this point some excellent cribwork of peeled timber was constructed for considerable stretches.

In the other portion (Rosedale to Yale) constructed by day labor, there was considerably more new construction work as the old road was very tortuous and narrow. In relocation, advantage was taken of the opportunity to eliminate several dangerous level railway crossings, the diversion at Floods involving the construction, at heavy outlay, of substantial retaining walls. As the location was through heavily timbered areas the clearing for the new portions was exceptionally heavy. The existence of several low-lying, swampy tracts called for special drainage ditches, and special foundations previous to the construction of the roadbed proper. On the many heavy side hills and deep excavations a gas shovel was kept busy, often on double shifts, and government trucks and power graders were freely employed in the gravel surfacing of this portion of the highway.

High and Low Rainfall in New England

"Years of high and low rainfall in New England have occurred in fairly-well defined groups traceable now for a period of a century in the case of some of the longer observations," said X. H. Goodnough, chief engineer Massachusetts State Board of Health, in a continuation of his "Rainfall in New England," published in the *Journal* of the New England Water Works Association last June. Mr. Goodnough said further: "Within the last century there were periods of high rainfall culminating in the years 1878, 1890, 1903, and again in 1922; while periods of low rainfall in that space of time culminated in 1883, 1894, and 1911. Since 1922 the annual precipitation has been declining, as shown by the 3-year progressive averages, though, judging from the recorded flows of the Nashua and Sudbury rivers, no intense drought has been reached as yet comparable with either of the three previous dry periods. The flow of the Nashua River for the year 1925, however, fell to about 78 per cent of the average, and the drought has continued into the present year, 1926."

Shrinkage of Hydraulic Fill for Huffman Dam

A Score of Settlement Pins Set in Dam Embankment Show Shrinkage of Slightly More than One-Half of One Per Cent

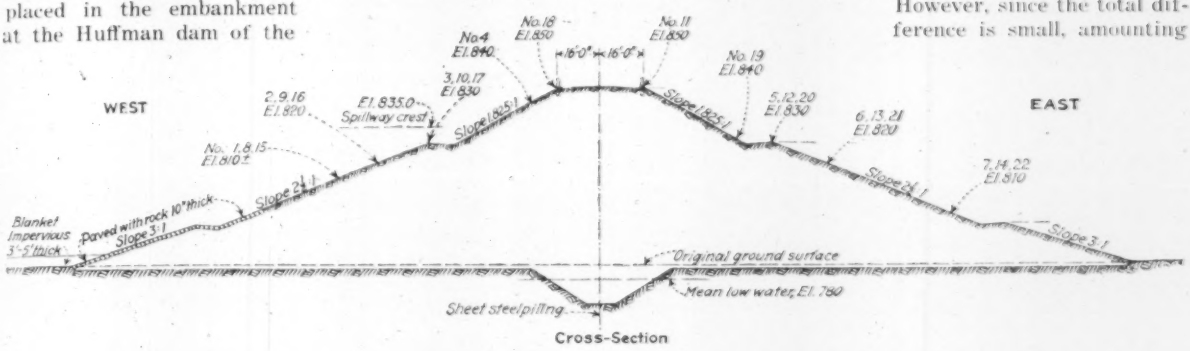
By C. H. Eiffert

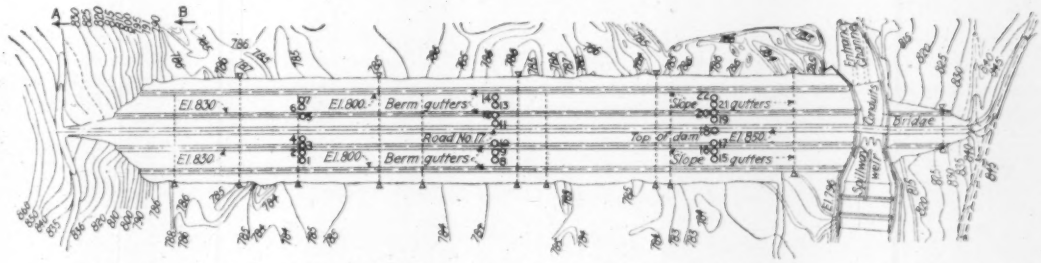
Chief Engineer, Miami Conservancy District, Dayton, Ohio

For the purpose of obtaining definite information as to shrinkage of hydraulic fill, iron pipes were placed in the embankment at the Huffman dam of the Miami Conservancy District. These pipes were 7 ft. in length driven into the fill at various elevations as the work progressed. Levels have been taken on them at various time intervals since the completion of the work. The levels were carefully run and checked from benchmarks outside of the dam. The locations and elevations of the pipe are shown in the drawing and the table gives the results of the readings.

Huffman dam is approximately 65 ft. high above the valley floor, the elevation of the top of dam being 850 ft. above sea level. Before any embankment was placed the site was thoroughly cleared of all trees, stumps and other vegetation. The area was then stripped of all top soil and perishable matter to a depth of from 6 to 12 in. and deeper where necessary. The material below this consisted principally of sand and gravel.

It is of course impossible to say how much of the difference in elevation is due to shrinkage of the fill itself and how much to settlement of the foundation. However, since the total difference is small, amounting at the present time to only 0.51 per cent, and since there was undoubtedly some shrinkage of the fill itself, the settlement of foundation in this case was probably negligible. That this is true is also indicated by the fact that there is no uniform increase in the percentage of settlement with the increase in the height of the dam, as should be the case if there had been settlement of the foundation.





LOCATIONS OF PINS SET TO MEASURE SETTLEMENT OF HUFFMAN HYDRAULIC-FILL DAM IN OHIO

SETTLEMENT READINGS AT HUFFMAN HYDRAULIC-FILL DAM

Pipe No.	Location	Elevation and Date 4-12-21	5-16-21	6-18-21	7-23-21	9-12-21	10-17-21	12-27-21	8-8-22	9-30-26	Total Settlement	Per Cent
1	West Side	810.0	809.97	809.95	810.01	809.94	809.92	.....	809.91	809.90	0.10	0.4
8	West Side	809.98	809.94	809.92	809.94	809.89	809.88	.....	809.86	809.84	0.14	0.55
15	West Side	810.02	810.00	809.97	809.98	809.95	809.94	.....	809.93	809.92	0.10	0.4
7	East Side	810.00	809.96	809.96	809.96	809.91	809.90	.....	809.88	809.83	0.17	0.68
14	East Side	810.02	810.00	809.98	809.99	809.94	809.96	.....	809.95	809.90	0.12	0.48
22	East Side	810.03	810.00	810.00	809.97	809.92	809.95	.....	809.89	809.87	0.16	0.64
2	West Side	.....	.....	820.00	820.03	819.96	819.96	.....	819.91	819.89	0.11	0.31
9	West Side	.....	.....	820.00	820.00	819.93	819.93	.....	819.87	819.85	0.15	0.43
16	West Side	.....	.....	820.00	819.99	819.94	819.93	.....	819.89	819.88	0.12	0.34
6	East Side	.....	.....	820.00	819.97	819.92	819.91	.....	819.88	819.82	0.18	0.51
13	East Side	.....	.....	820.00	819.97	819.91	819.92	.....	819.90	819.84	0.16	0.46
21	East Side	.....	.....	820.00	819.97	819.88	819.91	.....	819.85	819.81	0.19	0.54
3	West Side	.....	.....	.....	.....	830.00	829.92	829.86	829.79	829.75	0.25	0.55
10	West Side	.....	.....	.....	.....	830.00	829.91	.....	829.74	829.71	0.29	0.64
17	West Side	.....	.....	.....	.....	830.00	829.94	.....	829.79	829.76	0.24	0.53
5	East Side	.....	.....	.....	.....	830.00	829.92	829.84	829.82	829.73	0.27	0.60
12	East Side	.....	.....	.....	.....	830.00	829.95	.....	829.81	829.72	0.28	0.62
20	East Side	.....	.....	.....	.....	830.00	830.00	.....	829.85	829.80	0.20	0.44
4	West Side	.....	.....	.....	.....	.....	.....	*	839.70	839.59	0.41	0.73
19	East Side	.....	.....	.....	.....	.....	.....	.....	839.90	839.87	0.13	0.24
18	West Side	.....	.....	.....	.....	.....	.....	†	849.85	849.68	0.32	0.49
11	East Side	.....	.....	.....	.....	.....	.....	849.92	849.81	849.61	0.39	0.60
										Average	.....	0.51

* Set at 840.0. No record of date. † Set at 850.0. No record of date.

Multiple-Arch Retaining Wall Damaged by Slip

Novel Structure in Los Angeles Built on Part Rock and Part Earth Foundation—Center Portion Slowly Sliding Outward

By Fred A. Noetzli
Consulting Engineer, Los Angeles, Calif.

In connection with the relocation and widening of Cahuenga Ave.—one of the main traffic arteries leading out of Los Angeles between Hollywood and Lankershim, a multiple-arch retaining wall about 60 ft. high and 450 ft. long was built to hold the roadway embankment across Indian Gulch, on account of the limited width of right-of-way available at the time of construction. Originally a bridge had been planned, but comparative estimate made it appear that a retaining wall would be more economical, at the same time providing space for dumping surplus material from a nearby cut. Comparison of various types of retaining wall led to adoption of the multiple-arch type as the most feasible.

The two wings of the wall are built on rock, but in the center portion the excavation was carried 15 to 20 ft. below ground to what appeared to be a suitable foundation material.

Early Movement—On the day following the Santa Barbara earthquake (June 29, 1925), when the fill against the wall had been brought to less than half the ultimate height, a movement of approximately 2 in. was noted at one of the buttresses, and lesser amounts at the other buttresses which were not founded on rock. Contrary to expectations, the movement did not stop but continued at a more or less uniform rate until by now a maximum of 6 to 8 in. has been recorded. The direction of the movement is downward and outward, about 45 deg. to the horizontal. As not all parts of the wall moved, the wings being founded on rock, a number of cracks have formed in two arches and in the sidewalk and parapet on top of the wall.

Recently the acquisition of a strip of land which formerly was tied up in litigation has made it feasible to extend the fill beyond the former property line. This work is now in progress. It is planned ultimately to fill in the entire canyon to the elevation of the new boulevard, the retaining wall to be entirely covered by the fill.

Design—The arches and buttresses of the retaining wall were designed for earth pressure and live-load, assuming the fill to weigh 100 lb. per cu.ft. The arches are 12 in. thick at the crown and 15½ in. thick at the abutments, increasing uniformly from top to bottom, and have axial stresses less than 350 lb. per sq.in. The buttresses, spaced 30 ft., are 18 in. thick at the top and 24 in. thick above the spread footings, and have a maximum compression stress of about 325 lb. per sq.in. Both arches and buttresses are slightly reinforced.

The tops of the buttresses were connected by longitudinal beams supporting a sidewalk and a parapet. Two of the buttresses were built as section piers for architectural reasons.

The slope of the arches is 4½ horizontal to 10 vertical (Fig. 3). The controlling feature for the determination of this slope was the direction and magnitude of the earth pressure, a combination of the earth thrust against a vertical plane and the weight of the earth lying directly over the arches. The slope of the buttresses on the air side, 1½ horizontal to 10 vertical, was governed by the limitations of the right-of-way. The buttresses rest on spread footings of reinforced concrete, trapezoidal in shape to give as uniform a load distribution over the foundation area as practicable. The average footing pressure is 6,700 lb. per sq.ft. and the maximum pressure at the toe is 8,000 lb. per sq.ft. This was considered a permissible pressure for the foundation material encountered at a depth of 15 to 20 ft. below the ground surface. The footings are inclined as shown in Fig. 3. Cross ribs extending 6 in. below the bottom increase the sliding resistance.

Construction—The wall was built during the winter and spring of 1925. The foundation material upon which the central part of the wall was built consists of decomposed rock and soil presumably washed down from the adjacent hills. Both wings were founded on shattered and decomposed rock. Excavation was carried down a maximum of 20 ft. below the surface of the ground in the central part of the wall, and about 4 to 6 ft. in the wings. The arches extend approximately 5 ft. below the natural ground surface.

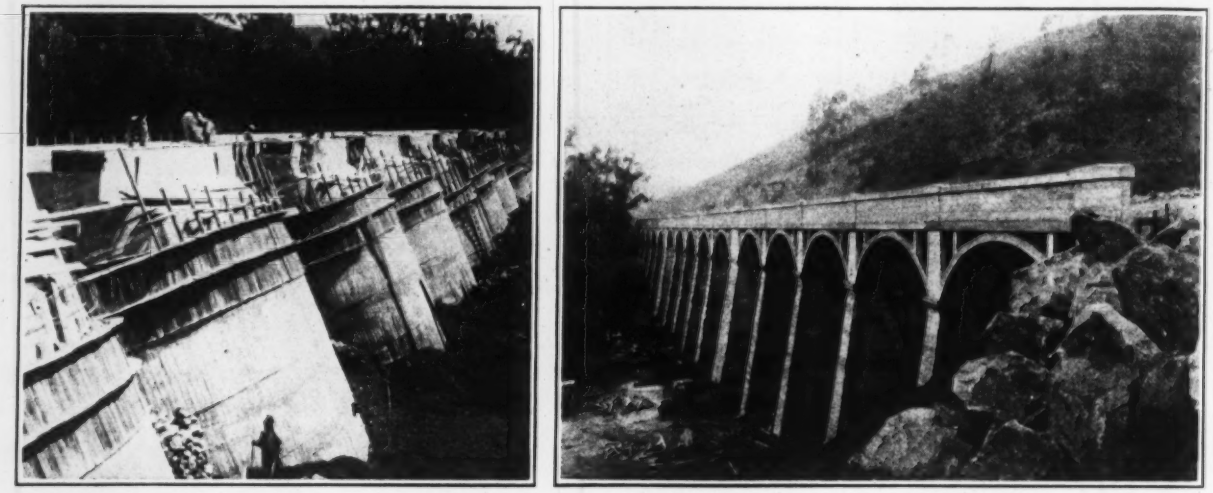


FIG. 1—CAHUENGA AVE. MULTIPLE-ARCH RETAINING WALL, WHOSE MIDDLE PORTION SLIPPED OUTWARD

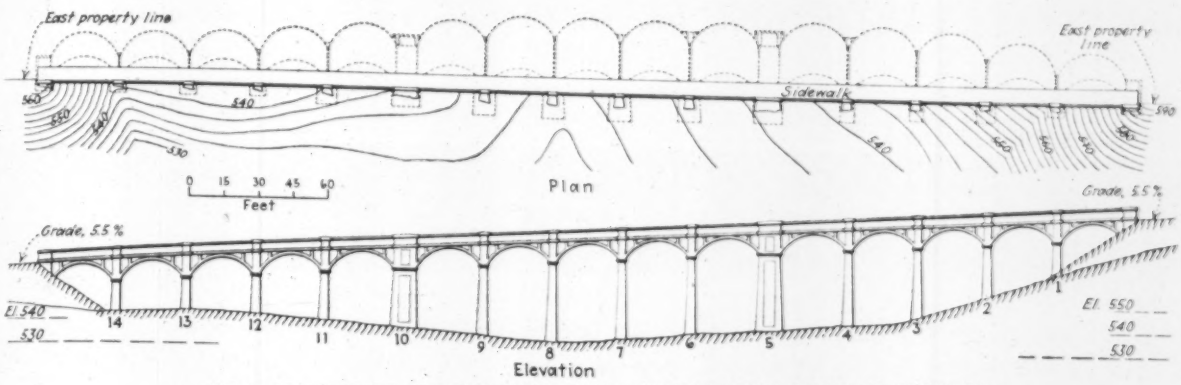


FIG. 2—MULTIPLE-ARCH RETAINING WALL ON CAHUENGA AVE., LOS ANGELES

The concrete of the arches and buttresses is 1:2:4, that of the footings about 1:2½:4½. Some of the fill behind the wall was brought in before the wall was entirely completed. The fill was compacted during placing by wetting it with a hose; after it had been brought up to the top of the wall and had settled for several months, it was again thoroughly wetted by jetting a pipe 5 to 7 ft. into the fill over the entire road area.

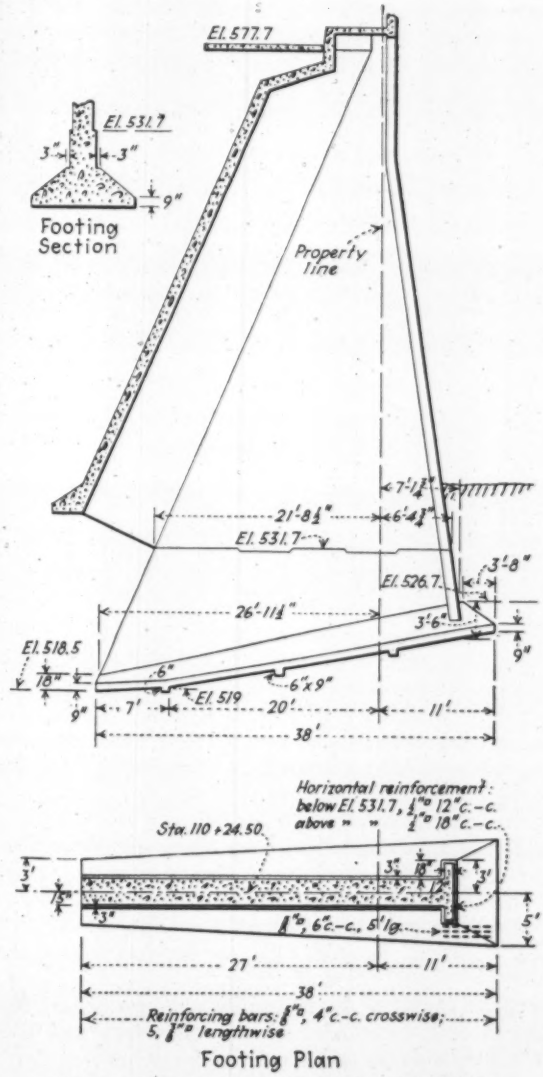


FIG. 3—CROSS-SECTION OF RETAINING WALL

As the retaining wall was built across a natural water channel, consideration was given to drainage. The plans provided for all the surface water flowing in the gulch to be carried beyond the fill in a concrete-lined surface channel. A spring was diverted in a special pipe. The wall itself has 6-in. drainage holes at the groin line of each arch, 6 to 10 ft. apart vertically, back of which loose rock was placed by hand. The effectiveness of the drain holes was proved on several occasions when small amounts of water were discharged through several of the lower holes.

Settlement—It was anticipated that the retaining wall would settle slightly under the loads imposed upon it. During construction, brass plugs were set in every buttress, and later the alignment and elevation of the plugs were measured at frequent intervals. Fig. 4 shows graphically the progressive settlement that took place; corresponding horizontal movements occurred, the direction of the movement being about 45 deg. downward. The settlement of each buttress footing was more or less uniform over its entire area. The movement of the wall was, therefore, due neither to overturning nor to sliding, but unquestionably to compression or other movement in the foundation material itself.

The maximum amount of movement which took place (up to the last measurements, in August, 1926), was approximately 7 in. horizontally and 7 in. vertically. As the first appreciable movement was observed immediately after the Santa Barbara earthquake (which was felt to some extent over large areas in Southern California), and some small cracks were found in one of the arches adjacent to the buttress which had settled the most, it was believed that the settlement was directly traceable to the earthquake and that the wall had again come to rest. However, as the curves of Fig. 4 show, the movement continued at a more or less uniform rate, about ½ in. per month.

At first thought one might suspect that wetting of the foundation due to improper drainage, or other causes, might be responsible for the settlement. However, the rainfall data in Fig. 4 fail to show any marked agreement between rainfall and subsequent rate of settling. Not even the disastrous floods of last April seem to have had any appreciable effect upon the wall. A 4x4-ft. pit excavated to the bottom of a footing after the first settlement had occurred failed to show any evidence of excessive moisture under the footing.

Borings show that in the central part of the wall the bedrock is about 22 ft. below the bottom of the footing.

On account of the limited right-of-way available at the time of constructing the wall, it would not have been feasible to carry the excavation down to bedrock. There would also have been difficulties with a foundation on piling on account of the large horizontal and vertical forces involved.

Conclusions—All the evidence available seems to indicate that either the foundation material under the center buttresses was compressed some 7 in., or the entire canyon overburden was forced out under the pressure of the fill which extended for several hundred feet up the canyon.

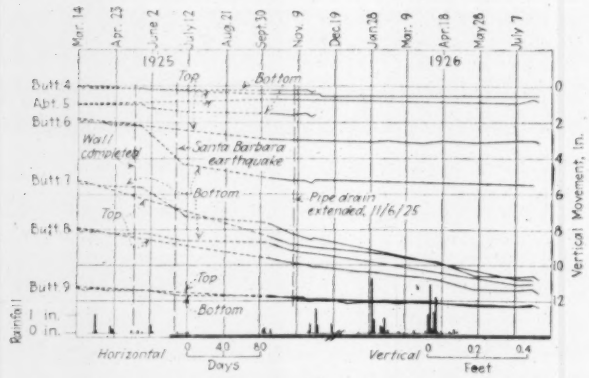


FIG. 4—PROGRESS OF SETTLEMENT OF WALL

It is the consensus of engineers familiar with the situation that the movement of the wall was due to a combination of the two causes. The rock surface below the center footings has a very steep slope, and this might account for a tendency of the overburden to slide down hill. It is improbable that the foundation material under the footings could have been compressed an amount of 7 in., as it had to be excavated with a pick and appeared to have sufficient bearing power to carry safely the 8,000-lb. loading.

One of the noteworthy things in connection with the behavior of this wall is the evidence that a structure of the multiple-arch type can undergo relatively large deformations without leading to a complete collapse. Although several cracks occurred in the arches, and the theoretical stresses were no doubt very high, no other signs of distress became apparent. Even after the full settlement of over 7 in. had occurred, the wall withstood the load of the fill and considerable vibrations from heavy truck traffic on the new road above the wall. It appears, therefore, that the multiple-arch type of construction has a large reserve strength over what could ordinarily be assumed in a design.

The Cahuenga Ave. retaining wall would unquestionably have been perfectly safe and adequate on a more suitable foundation.

For the rather peculiar foundation conditions at the site in question, it is probable that any type of retaining wall would have been subject to settlement, inasmuch as unquestionably certain dislocations of the foundation material were the cause for the movements of the wall. As stated previously, a foundation on rock was not feasible for various reasons.

The design of the wall was furnished by the writer. The construction work was done by force account by the city of Los Angeles, under the direction of D. L. Raeburn, construction engineer.

New Railway Train-Ferry In Japan

Railways of Islands Connected by Train Ferries Crossing Open Sea—Ferry Steamers and Terminals—Quay Walls

By M. Nawa
Engineer; Japanese Government Railways, Tokyo, Japan

In the four main islands of Japan, the mileage of railway line operated in 1924 was 7,548 miles of the State Railways and 2,941 miles of private railways, or 10,489 in total. This is exclusive of lines in Chosen and Taiwan. The increase in freight traffic between the islands, the demand for lower freight rates and the necessity of prompt and punctual delivery of goods led to public opinion that train-ferry service should be established at least between the main islands. The locations of these ferries and the railways are shown in Fig. 1. In July, 1911, a car-ferry was established between Shimonoseki and Komorie (2 knots or 2.3 miles) to connect the islands of Honshu and Kyushu. In October, 1921, another was opened between Uno and Takamatsu (11 knots or 12.65 miles), to connect Honshu and Shikoku.

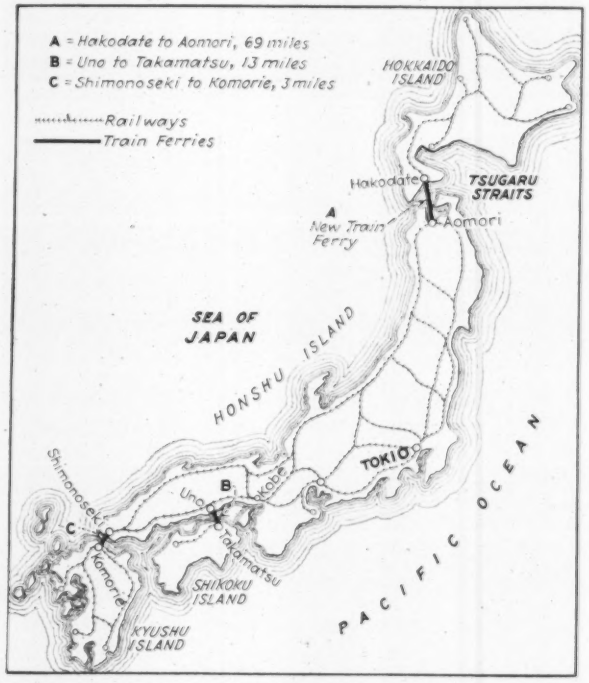


FIG. 1—TRAIN FERRIES OF JAPAN

Through traffic by car ferry between the islands of Honshu and Hokkaido had been made very difficult by the long sea-route across the Tsugaru Straits and also by the fact that automatic car couplers were used in Hokkaido alone, screw couplers prevailing in all other parts of Japan. In July, 1925, car couplers were standardized by the adoption of automatic center couplers for the entire country. Ferry landings had previously been built at both terminals, Aomori (Honshu) and Hakodate (Hokkaido), and the train ferry was opened to freight traffic as soon as the couplers were standardized.

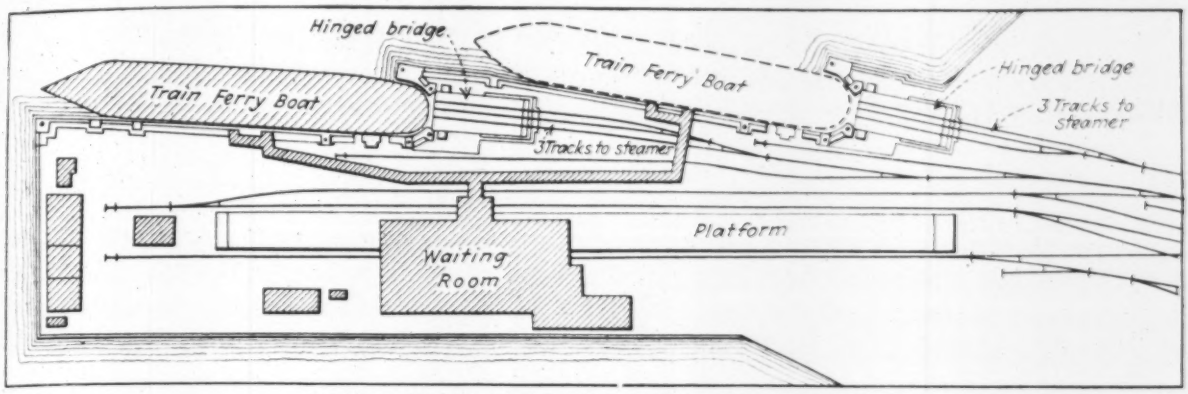


FIG. 2—NEW TRAIN FERRY TERMINAL AT HAKODATE

Thus, the ferry service between Honshu and the other three large islands, which make Japan proper, has been completed. The latest one, between Aomori and Hakodate, covers 60 knots, or 69 miles, about 4.5 hours being required at sea and terminals.

Hakodate-Aomori Train Ferry—Four ferry boats have been built for this line, all of about the same type. Three are kept in service and one in reserve. They make four round trips daily. For the "Matsumae-maru," built by the Mitsubishi Shipbuilding Co. in 1924, the main dimensions are: Length over all, 360 ft.; beam, 22 ft.; molded depth to car deck, 22 ft.; loaded draft, 15 ft.; displacement, 4,250 tons; speed 17 knots. Six water-tube boilers serve two sets of impulse turbines driving twin screws 11 ft. in diameter and 13 ft. 3 in. in pitch. Passenger accommodation is provided, equal to that on ordinary steamers, and the "Matsumae-maru" has capacity for 39, 198 and 700 passengers of first, second and third class, respectively, or a total of 937 passengers. In general arrangement, this train-ferry boat is similar to an ordinary ocean-going steamer, except that at the stern the superstructure is cut away to the level of the car deck.

At the stern, where cars enter and leave the steamer, there are three tracks of 3½-ft. gage on the car deck. The middle track extends only as far as the engine room, but the two side tracks extend well forward toward the bow. The arrangement of the tracks is shown in Fig. 4. On each boat the total length of track is 674 ft., with capacity for twenty-five 15-ton cars, or twenty 15-ton cars and two brake-vans or cabooses of the bogie or double-truck type. For safety, the boats are made double-bottomed, and each of the water-ballast tanks is divided into small compartments where the water is pumped in or out as required to maintain a constant draft. To provide against the heeling of the boat if more heavily loaded on one side, wing water-tanks are installed, each with a capacity of 140 tons of water. These tanks are served by pumps which enable the entire quantity of water to be removed from one side to the other in four minutes.

Rail-and-Water Terminals—At Hakodate there are berths for two boats alongside the mole or quay, which extends as far as the Hakodate station yard, as shown in Fig. 2. For the convenience of passengers, covered

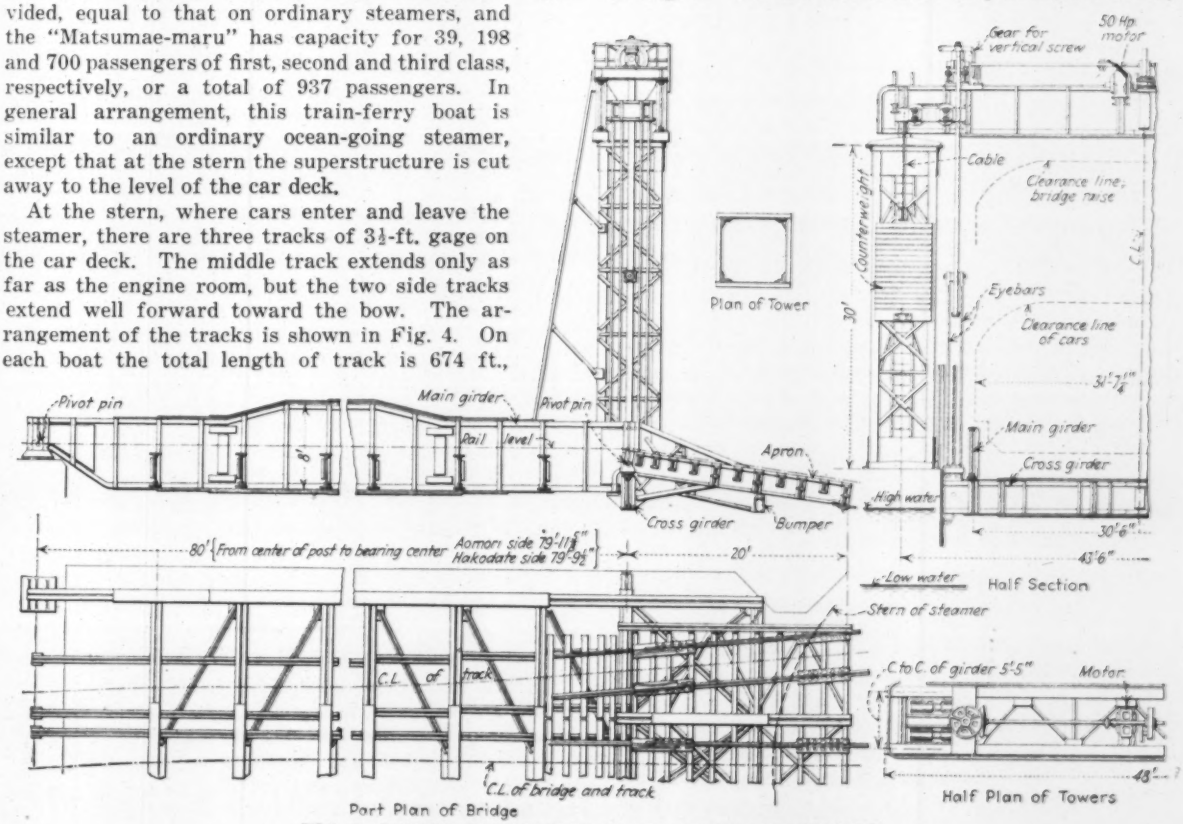


FIG. 3—BRIDGE CONNECTION TO T[illegible]N FERRY STEAMER

walks extend from each berth to the waiting-room on the quay. This quay, Fig. 5, has walls of hollow concrete caissons sunk in place on a bed of loose rock and then filled with sand, except that the water-front side is reinforced by an interior wall of concrete, as shown. Upon these caissons is a superstructure or dock wall of mass concrete, and the space between the two lines of caissons is filled with sand.

From the track layout in the station yard, a lead track extends to each steamer berth and opens out into three tracks spaced to correspond with these on the vessel. To provide for the varying difference in level between the tracks on shore and those on the steamer, a hinged bridge is provided, as shown in Fig. 3. This consists of 8-ft. girders 80 ft. long, carrying at the outboard end a hinged 20-ft. apron which seats on the stern of the boat's car deck. This bridge is raised and lowered as required by means of vertical screws driven by gearing and connected to the ends of the outer girders by eyebars. To balance the weight of the bridge, which is about 108 tons, cables attached to a cross girder pass over sheaves and carry counterweights. The counterweight sheaves and the operating mechanism, with 50-hp. motor, are mounted on an overhead structure carried by steel towers.

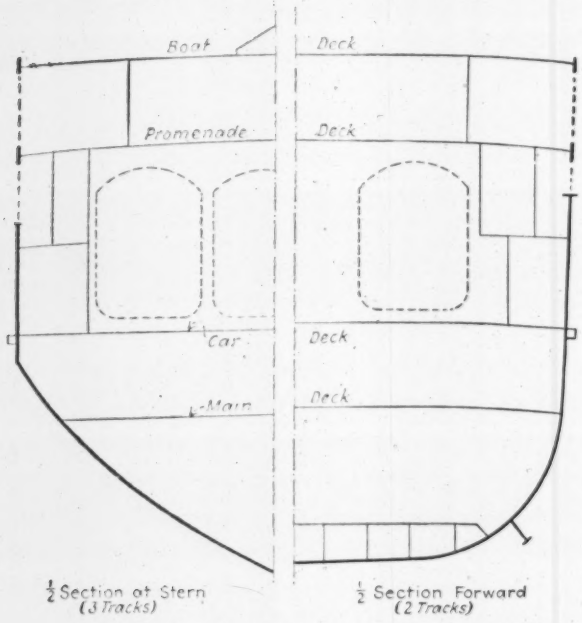


FIG. 4—SECTIONS OF FERRY STEAMER

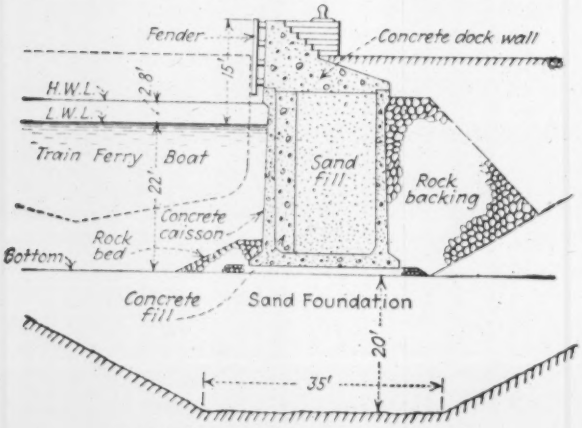


FIG. 5—QUAY WALL CONSTRUCTION

At Aomori, there is only one berth at present, but another will be built before long. Here the quay walls are built partly of hollow concrete caissons, and partly of solid concrete blocks laid up like masonry, each construction being capped with a mass concrete wall.

High-Silicon Structural Steel Found Strong and Tough

PHYSICAL tests of a number of samples of "Freund," or "F," steel, a much-discussed material produced in Germany within the past two years, were made recently at the Bureau of Standards. They show that this material combines high tensile strength and yield-point with high ductility and toughness. Six groups of specimens tested ranged from 54,000 to 58,500 lb. per sq.in. yield-point, and 73,000 to 79,500 ultimate strength, with 23½ to 26 per cent elongation in 8 in. At the same time the samples were very tough, giving an Izod impact test value of 58 to 86 ft.-lb. without shattering the specimen.

As reported in Technologic Paper 331 of the Bureau of Standards, just issued (H. W. Gillett, "High Silicon Structural Steel"), the steel is not an ordinary carbon steel, but should be classed as a silicon alloy steel. It proved to be low in carbon (0.11 to 0.15 per cent), and high in manganese and silicon (Mn 0.35 to 0.79 per cent, Si 0.89 to 1.23 per cent). Doctor Gillett says, "It is evident that silicon, at least when present in amount above 0.50 per cent, should be classed as a true alloying element. Its effect in raising the yield-point is marked."

This steel was brought out as a new product by the J. C. Freund Co., a German steel works, and was proposed as a general structural material to replace the mild and medium steel grades currently used on the Continent. Its qualities were said to be due to the use of a special furnace (Bosshardt furnace), but other steel makers have made steel of the same composition and properties in ordinary openhearth furnaces.

Doctor Gillett reviews prior data and publications on silicon and manganese steel, and shows that steels of similar composition have been made and used previously. He concludes:

"The properties of the Freund steels can be closely attained with steels of, say, 0.15 per cent C, 1.50 per cent Mn; 0.25 per cent C, 1.00 per cent Mn; or 0.25 per cent C, and 0.75 per cent Si; with the single exception that the reduction of area may not, when the carbon is as high as 0.25 per cent, be quite up to that of the 0.12 per cent C, 1.00 per cent Si, Freund composition. The relative advantages of manganese and of silicon as alloying elements will depend somewhat upon their relative prices. American steelmakers might find it worth while to be prepared to use silicon for making high-yield-point structural steels in periods when ferromanganese is high and ferrosilicon low, as previously pointed out by Burgess."

Canada Develops More Water Power

Canada has added 266,000 hp. in new hydro-electric plants according to a statement by Charles Stewart, Minister of the Interior. This brings the total installation to 4,566,000 hp. Projects actually under way will add 1,700,000 hp., and projects in active prospect will add 1,000,000 hp.

Developing Power on the Gatineau

1 *Three Plants Under Active Construction*

First of three articles on an initial 400,000-hp. hydro-electric development in Quebec

CONSTRUCTION is in progress to develop 400,000 electric horsepower on the Gatineau River in Quebec. This work comprises three hydro-electric plants in the lower reaches of the river; a group of storage dams in the upper reaches of the river, and a large paper mill near Ottawa. The power development will cost $50,000,000. The current generated at the three plants will be marketed, a very considerable proportion going to the new paper mill of the Canadian International Paper Co. The International Paper Co. is carrying out the development through its subsidiary, the Gatineau Power Co., which controls these three and other power rights on the Gatineau. Control of the storage works, however, is in the hands of the Quebec Streams Commission. This article outlines the general plan of the present development.

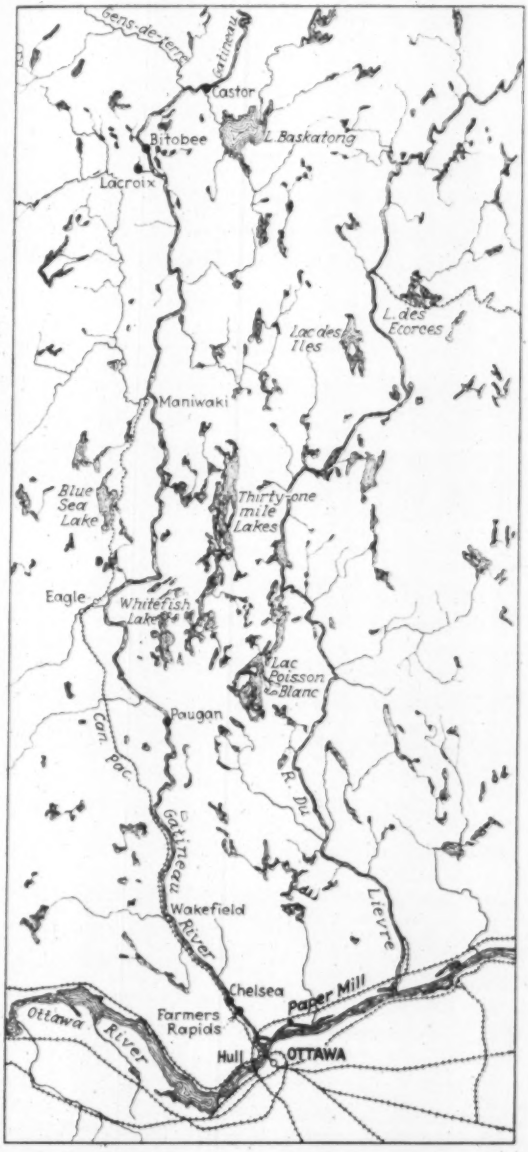


FIG. 1—LOCATION MAP OF POWER DEVELOPMENT OPERATIONS ON THE GATINEAU RIVER, QUEBEC

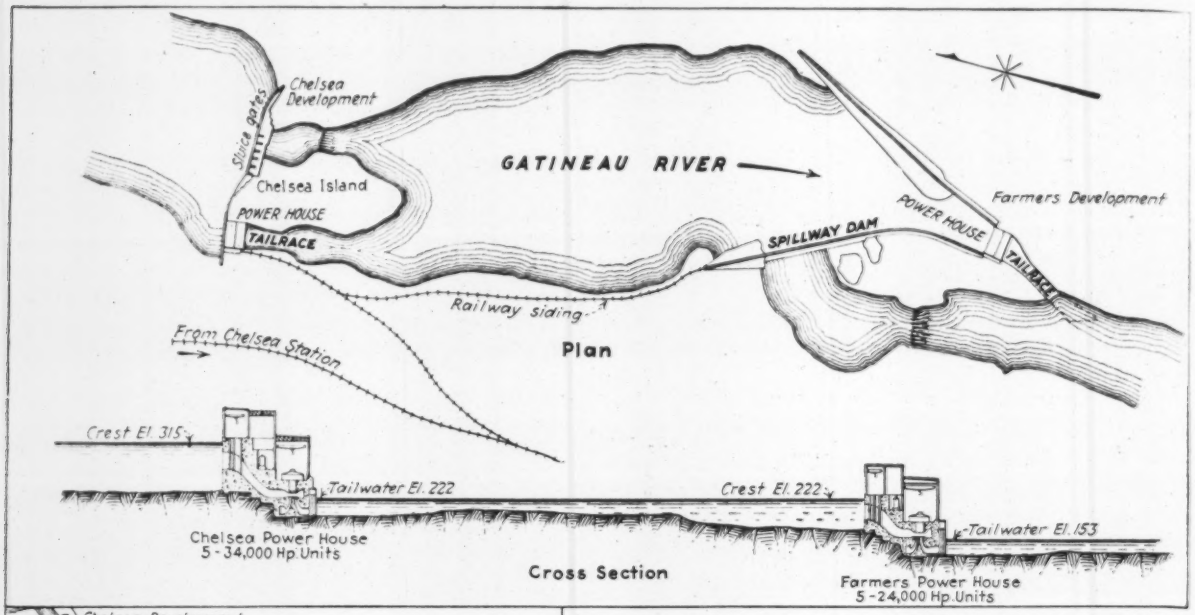
Power Possibilities of the Gatineau—The Gatineau River, shown by the accompanying map, Fig. 1, has a drainage area above Chelsea of 9,600 sq.mi. The high level of the storage lake being created at Lake Baskatong is 755 ft. above tidewater, and the water level below Farmers Rapids, the lowest fall in the river, is at El. 157, giving a total fall of 598 ft. in a river length of 120 miles. Only parts of this fall, where drop and topography make power plants feasible, can be utilized. The three principal points of development are Paugan Falls, Chelsea Falls and Farmers Rapids whose falls are respectively 115 ft., 95 ft., and 65 ft., a total of 275 ft.

Based on storage possibilities as they are explained later, 10,000 sec.-ft. regulated flow is assumed. At 60 per cent load factor this will require 450,000 hp. of water wheels. With 10 per cent loss from shaft to point of delivery there will be 405,000 hp. delivered 60 per cent of the time. On the same basis other available falls on the river will add about 200,000 hp. In round figures the power possibilities are 600,000 hp.

Storage Possibilities—Surveys by the Quebec Streams Commission disclosed that an enlarged Lake Baskatong of some 64,000 acres and draining 6,200 sq.mi. could be created by building seven dams, four of them small earth structures and three of them concrete dams, one of which contained the control works. The dams will give a lake level of El. 755, at which some 86,000,000,000 cu.ft. of water will be impounded, which, with the natural runoff below the dam, will provide a regulated flow of 8,000 to 10,000 sec.-ft. The storage works will cost about $3,000,000.

Gatineau Power Plants—The Chelsea and Farmers Rapids plants are complementary developments and will be operated in synchronism. They are indicated in the sketch plan Fig. 2 which also shows their location relation to the paper mill which will consume a considerable portion of the power generated. Description of the plants will, however, be kept separate. The ten units at these two plants will develop 290,000 hp.

At Chelsea the crest elevation of the spillway is 315 ft. but at periods of low flow flashboards will hold the elevation at 318 ft. The dam will set back the water about to the village of Wakefield, Fig. 1, and will require moving back onto higher ground about 6 miles of railway and highway on the west side of the river. As indicated by Fig. 2 the power house will be between the island and the west shore of the river. The dam between the island and the east shore of the river is to contain flood gates and across the island will be the spillway. The power house has been designed for five turbines of 34,000 hp. each at 95-ft. head, the turbines running at a speed of 100 r.p.m. The turbines will be



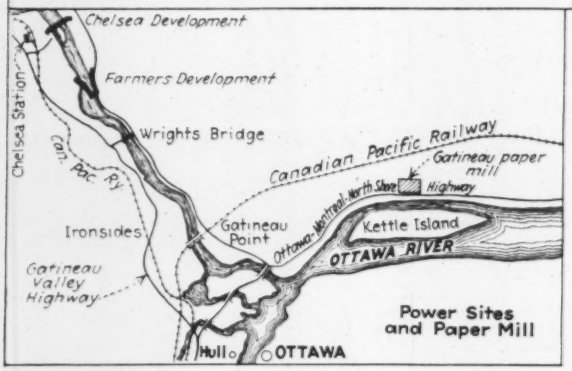


FIG. 2—LOCATION MAP OF POWER PLANTS AT CHELSEA AND FARMERS RAPIDS, GATINEAU RIVER

of the Francis vertical type and will each drive a 36,000-kva. generator. Fig. 3 is a section through the power house. Water after passing through the wheels and draft tubes will come into a tailrace which will extend 1,200 ft. from the power house through the channel between the island and the west shore. The generators will produce current at 6,600 volts which will be stepped up to 110,000 volts for distribution.

At Farmers Rapids, about 7,000 ft. below the Chelsea dam, the plant will contain five Francis type turbines of 24,000 hp. each, directly connected to generators. On account of the short distance between the two plants the Chelsea and Farmers Rapids plants will be run in synchronism, that is to say, each plant will use the same amount of water at the same time. The arrangement of dam and power house will be noted from Fig. 2 which also gives the essential elevations. Fig. 4 is a section through the power house at the Farmers Rapids development.

At Paugan Falls only preliminary work has been commenced. The plant, however, will develop about 150,000 hp., with equipment of the same general character as at Chelsea and Farmers Rapids. At these two plants there will be both 60-cycle and 25-cycle units. Power will be used at the paper mills now building at West Templeton, about four miles below Ottawa on the Quebec side of the Ottawa River and by others as the demand may require. It is planned to sell the 25-cycle current from these plants to the Hydro-Electric Power Commission of Ontario and also to develop Paugan Falls at 25 cycles. This 25-cycle current from all three plants will be sent into the province of Ontario over a 220,000-volt transmission line.

Paper Mill—The paper mill approaching completion at West Templeton will be called the Gatineau Mill. The first unit will contain four paper machines, capable of producing a sheet of newsprint paper 256 in. wide at a rate of 1,200 ft. per minute. These machines will be the largest single producers so far installed in the world.

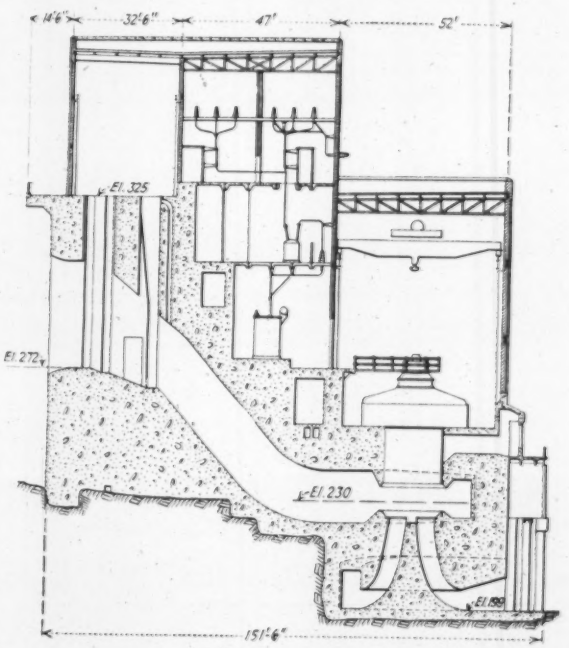


FIG. 3—SECTION THROUGH POWER HOUSE AT CHELSEA

The paper mill will require some 39,000 hp. for grinding wood and for miscellaneous needs about the mill. In addition, electric boilers will be installed to use surplus electrical energy until such time as the demand for

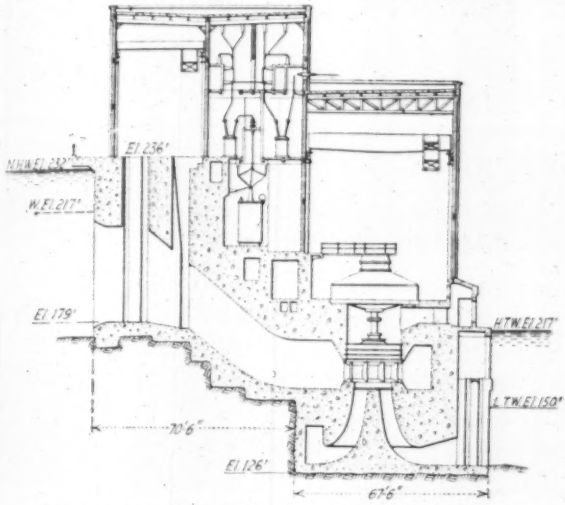


FIG. 4—SECTION THROUGH POWER HOUSE AT FARMERS RAPIDS

such energy no longer warrants its use for making steam.

Engineers and Contractors—A. H. White is chief engineer of the International Paper Co., New York, and O. Lefebvre is chief engineer of the Quebec Streams Commission, Montreal. The Foundation Co. of Canada, Ltd., Montreal, has the contract for the storage reservoir works and Fraser-Brace Engineering Co., Montreal, are engineers and contractors for the power plants and the paper mill.

[*Two succeeding articles will analyze outstanding construction features in building the storage reservoir and the power plant dams for the present power development of the Gatineau River.*]

Tube Railway Altered Under Traffic

To provide a new siding between the two single-track tubes of the City & South London Ry., at London, England, at a location where the tubes have a 10-ft. difference in elevation, the main part of the third tube was built by the pneumatic process, working through clay and quicksand. The new tube is about 720 ft. long, extended at each end by a length of 320 ft. which telescoped the original tubes, being of much larger diameter than the latter to allow for the turnouts. These end connections begin with 27½ ft. diameter and reduce by steps to 21 ft. 3 in. While this large end bore was being excavated in short sections by hand, the original iron-lined tube had its base supported by jacks and blocking while the sides were braced by radial struts. To prevent the compressed air from escaping into the old tube or tunnel, the grouting holes in the cast-iron lining of the latter were plugged from the inside. The final step was the removal of the old lining inside the new and larger bore. This work was done from the outside, and then the new concrete floor was placed. Although trains in both tubes were operated at intervals of only two or three minutes during the greater part of the day, the work was carried out with little or no interruption to traffic.

Alumina Cement Caps Successful on Hardened Concrete Specimens

Show Good Adherence to Specimens, May Be Stored in Water and Permit Tests to Be Made Sooner Than with Caps of Other Materials

By O. V. Adams
Testing Engineer, Colorado State Agricultural College

During the past year an investigation has been conducted on concrete pavements in Colorado, in which 240 cores approximately 4¾ in. in diameter, and from 4 to 8 in. long, were taken from the pavements for test work. Before testing, all of these cores had to be capped on both ends, and various materials and methods were tried in an attempt to secure a satisfactory cap.

It was recognized that a satisfactory capping material should possess the following characteristics: (1) Its compressive strength at time of test should be at least as high as that of the specimen; (2) it should adhere readily to the surfaces of the hardened concrete; (3) it should permit the specimen to be stored in water after capping; (4) it should be economical and easily applied.

Neat portland cement was found to give satisfactory strength for a cap, provided it was made long enough in advance. Such caps did not, however, always adhere to the specimen. Plaster of paris did not develop satisfactory strength, and did not stand up under water storage. A grinding lap was considered, but not used, because of the initial cost.

The final selection was a 1:1 mortar of alumina cement and fine sand. The ends of the cores were dressed to approximately plane surfaces by means of a small air hammer. Light sheet metal collars were then fastened around each end and made perpendicular to the axis of the specimen. The collars were filled slightly more than full with the material, and the excess pressed out by means of a heavy glass plate, upon which a thin coating of cup grease had been applied to prevent adhesion. The mortar was mixed just before being used, and the glass plate and the collars were removed 16 to 24 hr. after capping. The specimens were then stored in water 48 hr., and tested. Standard 6x12-in. test cylinders are treated in the same manner, except that no metal collars are necessary where the ends are reasonably true. Of the 240 cores taken from the concrete pavements, and in addition a number of 6x12-in. cylinders, only one cap has pulled loose from the specimen, this failure being attributed to free water on the end of the core. Although the cores should always be moist, no free water should be present when the cap is applied. It was found that the use of acid or other chemicals is not necessary to secure satisfactory adhesion.

The advantages in using alumina cement for capping concrete specimens may be summarized as follows: (1) The mortar may be prepared just before being used; (2) it adheres readily to old concrete surfaces; (3) specimens may be tested in minimum time after capping; (4) specimens may be stored in water as soon as the caps are hardened; (5) when used in thin layers, with proper consistency, it does not pull away from the glass plate due to shrinkage; (6) the cost is low, being not over one cent per specimen.

Bill for Department of Public Works and Domain Submitted to Congress

Name of Department of Interior to Be Changed to Public Works and Domain—Some Bureaus to Be Transferred Intact, Others Formed in Part from Bureaus of Other Departments

A BILL providing for the formation of a number of new governmental bureaus and the regrouping of allied existing bureaus, all to be gathered together in a department to be known as the Department of Public Works and Domain, has been submitted to the House of Representatives. The new department will replace the present Department of the Interior and its head will be the "Secretary and Directing Engineer of Public Works and Domain," who will be a cabinet officer in place of the Secretary of the Interior. This move is another attempt to consolidate the various functions and activities pertaining to the administration of public works and public domain of the United States Government into one department. The bill was prepared by the Committee on Organization of Federal Public Works appointed by the American Engineering Council, a committee consisting of E. O. Griffenhagen, chairman, of Griffenhagen & Associates; Wallace Clark, industrial engineer; John Price Jackson, New York Edison Co.; J. L. Jacobs of J. L. Jacobs & Co.; Elwood Mead, Director of Reclamation; Sanford E. Thompson, of the Thompson & Lichtner Co.; and W. F. Willoughby, of the Institute of Government Research.

In making its study, the committee states that it first listed every function and activity of the federal government that had been or might be seriously considered for allocation to such a department as was under consideration. Each unit now handling these functions was given consideration and every practical question raised by the proposal to alter its present relationship with other parts of the larger organization in which it is now located was considered, such as joint use of plants, offices or staffs, sharing of overhead and service charges, and interlocking of operating procedure. These activities were found to fall into two classes, those that should be included in the new department and those that should not be included but should be served by it. The committee defines the term "include" as meaning that the functions and staff as needed should be taken over by the proposed department, and the term "serve" to mean that the new department would give certain technical advice to the unit or act as contractor in handling certain of its work when called upon. As a result of this study, the committee made the following determination:

Of the Department of the Interior the following organizations should be included, Geological Survey, Bureau of Reclamation, the Alaska Railroad, National Park Service, and General Land Office. The Office of Indian Affairs and the administration of Alaska and Hawaii should either be "included or served." Of the Department of Agriculture, the Bureau of Public Roads and the Forest Service should be included, except the Rural Engineering Division of the first and the silvicultural functions of the latter. The Weather Bureau is not included. From the War Department the *non-military* river and harbor work of the following branches are all to be taken over: Office of the Chief of Engineers, Board of Engineers for Rivers and Harbors, Mississippi River Commission, California Debris Commission, Supervisor of the Harbor of New York, Northern and Northwestern Lakes Survey. Certain *municipal* functions in the War Department pertaining to the District of Columbia are either to be served or included, and pertaining to the Board of Road Commissioners for Alaska and the Alaska Telegraph and Cable System are to be included. The following are to be "served," the National Military Parks, National Monuments and Memorials, Inland Waterways Corporation, Bureau of Insular Affairs, and the Construction Service of the Quartermaster General's Department.

From the Treasury Department the Office of the Supervising Architect is to be included and the Public Health Service is to be "served." From the Department of Commerce the Coast and Geodetic Survey (primary control works only) is to be included. The Bureau of Lighthouses is to be served. The Hydrographic Office of the Navy Department, the Bureau of Mines and Bureau of Standards are not to be included.

The following independent branches are also disposed of. The Federal Power Commission and the Office of Public Buildings and Public Parks of the National Capital are included. The Panama Canal and Canal Zone, and the U. S. Shipping Board and Emergency

Proposed Department of Public Works and Domain

Bureau of Administrative and Technical Service
Divisions of Administrative, Technical and Independent Service.

Bureau of Architecture and Public Buildings
Divisions of Architectural, Structural and Mechanical Design, Construction and Inspection, Repairs, Management and Operation.

Bureau of Waterways and Ports.
Division of Waterway Economics, Technical Divisions, Field Divisions and Districts.

Bureau of Public Roads
Division of Highway Economics, Technical Divisions and Districts.

Bureau of Geological Survey
Divisions of Land and Topographic Surveys, Geological Investigations and Natural Resources.

Bureau of Reclamation and Power
Divisions of Reclamation Economics, Legal, Water Power Investigations, Technical Divisions, Field Divisions and Districts.

Bureau of National Parks and Forests
Divisions of Park Operation and Forest Control.

Bureau of Utilities
To operate government-owned utilities.

General Land Office
Organized about as now.

Bureau of Indian Affairs
Organized about as now.

Fleet Corporation are to be served. The Department is to affiliate with the Board of Surveys and Maps of the federal government and the Commission of Fine Arts. It is to serve the Rock Creek and Potomac Parkway Commission and the National Capital Park Commission, and to include the American Battle Monument Commission, the departmental services for maintenance and operation of buildings, and the Architect of the Capitol.

Plan of Organization—The Committee has based its plan on the assumption that the proposed department should follow *service* rather than *functional* lines and has arranged its proposed bureau accordingly. The head of the department is to be "Secretary and Directing Engineer of Public Works and Domain." He is to have an assistant directing engineer who shall perform all his duties during his absence, who shall be appointed by the President from civil life and be specially qualified by technical training and experience to administer the affairs of the department. The directors of the several bureaus, not over six in number and having various titles, are to rank equally with the assistant directing engineer.

The new bureaus proposed are: Bureau of Administrative and Technical Service, which is to be divided into three divisions of administrative, technical and independent service; Bureau of Architecture and Public Buildings, under the Chief Architect of Public Buildings, which is to have divisions of architectural design, structural design, mechanical design, construction and inspection, repairs, management and operation; Bureau of Waterways and Ports under the Chief Engineer of Waterways, who shall in the first instance be an officer of the engineer corps nominated by the Chief of Engineers. This bureau shall be divided up into an administrative service unit, a division of waterway economics, technical division at Washington headquarters as required, and field divisions and districts.

Other bureaus are to be: Bureau of Public Roads, under Chief Engineer of Public Roads, with an organization similar to that of the Bureau of Waterways and Ports. Bureau of Geological Survey under a Director of Geological Survey, with divisions of land and topographic surveys, geologic investigation and of natural resources. Bureau of Reclamation and Power under a Chief Engineer of Reclamation and Power; this bureau would have a legal division, divisions of reclamation economics and of water power investigation, and technical divisions at Washington headquarters with field divisions and districts. Bureau of National Parks and Forests under the Director of National Parks and Forests, with divisions of park operation and forest control, each having technical headquarter sections at Washington and field staffs. Bureau of Utilities, which is to be organized for the administration of government owned utilities such as telephones, cable lines, inland waterway carriers and the like. A General Land Office and Bureau of Indian Affairs are to be organized about as at present. The committee suggests that the Bureau of Indian Affairs may be set up independently.

Fundamental Principles—The principles observed in preparing this organization plan were the allocation of functions and activities along natural lines, the provision of strong unifying central control and for deputizing executive authority, the separation of executive and routine functions, the centralization of such functions as purchasing, accounting, record keeping, filing, supplies and typing, and the organization of each department to suit its needs rather than to conform to any definite plan for a general organization.

This is separation into bureaus rather than the proposed alternative of partitioning the work of the department into four departments, namely; (1) the design and supervision of architectural work, (2) the design and supervision of engineering work, (3) the administration and execution of the construction work of the department, and (4) public domain. The former plan was selected because the latter plan cut horizontally through certain projects, throwing the planning into one or two bureaus, the construction into another and the supervision into one or both of the designing bureaus.

Directing Authority—The committee proposes the title "Secretary and Directing Engineer of Public Works and Domain" for the head of the department, the word "engineer" not to be construed in its narrow sense. The deputy is to be entitled "Assistant Directing Engineer," a term chosen to eliminate the objectionable term "Assistant Secretary," which is generally taken to be an exalted clerical position rather than that of an engineering executive. The committee is opposed to heading the various bureaus by assistant secretaries. Rather, it proposes chief engineers or directors, as noted above, with equal rank to the assistant directing engineer.

Service Agency—The committee has recommended service units to concentrate the functions involved in the work of all bureaus and of a nature to facilitate the work of all bureaus into "administrative service units" and "technical service units." It says that "the argument for the setting up of such general office agencies and technical staff service to take over those operations common to all the operating bureaus is the same argument that is confirmed by a thousand consolidations in the business world which lie at the root of the efficiency inherent to large scale operation and mass production." An example of the way in which it is proposed to use the service units is in the case of the Post Office Department requiring a new post office. Under the proposed plan, the requirements of the department will be transmitted to the Bureau of Public Works and Domain which will serve the Post Office Department through the designing and construction of the proposed building.

War Department Functions—The committee suggests that all non-military river and harbor work with its organization and personnel be under the direction of the Secretary of Public Works and Domain rather than the Secretary of War. It also suggests that the two cabinet officers work out a plan whereby members of the Corps of Engineers will have made available to them a more comprehensive plan of practical training through the classification and grading of engineering positions and the establishment of appropriate corresponding ranks in the military service upon which assignments may be based. In this way both officers of the military establishment and civilian engineers in the department will have equal opportunity to fill all the positions up to that of chief engineer, a condition which is not possible under the present arrangement and which works to the disadvantage of civilian engineers in the service.

American Society of Civil Engineers Holds 74th Annual Meeting

Proceedings Confined to Research Committee Reports and Technical Division Meetings—Papers Read Before Seven Divisions—Investigations of Skew Arches and Steel Columns Reported

AN ATTENDANCE commensurate with its rapidly growing membership marked last week's annual meeting of the American Society of Civil Engineers at New York, the 74th in the society's history. The meeting followed the trend of recent years toward concentrating all activity in the proceedings of the technical divisions, apart from the reports of research committees of the society as a whole. Seven divisions held busy and well attended meetings, under better arrangement than in some previous years, so that the confusion of distantly located meetings was eliminated. Their proceedings and the reports of the technical committees, which latter brought forth some interesting new facts on skew arches and on steel column strength, are briefly reviewed below. A general report of other facts of the meeting will be found in the news pages, supplementing the news report published last week.

Five Technical Committees Report

Bridge Specifications—Progress was reported by the joint conference committee of the society and the American Railway Engineering Association on steel railway bridge specifications, according to the report of H. B. Seaman, vice-chairman. The committee has been at work for a year, attempting to harmonize the specifications of the two societies. It has agreed on a radical departure from present design practice (designing for actual present-day loading as maximum, at a low unit stress), by using a base stress 25 per cent higher (20,000 lb.) and a live-load 25 per cent above the current maximum, this increased loading being approximately represented by E-80. Further protection against future growth of live-load is provided by requiring that a bridge shall be so proportioned that 30 per cent greater live-load shall not produce stresses more than 30 per cent above the allowable. The committee favors elimination of the restriction to spans under 300 ft. which features the A.R.E.A. specification, and plans to make the new specification apply to all lengths of span.

Many important subjects are still unconsidered or not agreed on; among the latter, the subjects of clearances, live-load, impact, eyebars and their testing, alloy steels, and materials, have been assigned to subcommittees for study.

Highway Bridge Impact—No additional work was reported by this committee (Prof. A. H. Fuller, chairman), but a further report is under preparation, although the 1926 report was presented as a final report.

Steel Columns—Prof. F. E. Turneaure reported in a brief oral presentation a summary of very illuminating tests made by the steel column committee during the past year.

Columns of I-section with solid web, with lattice bars and with batten plates, were tested in part under diagonal loads giving 2 per cent and 5 per cent shearing stress, and in part under eccentric loads. The shear distortions were two to three times as great for the lattice columns as for the solid-web columns, and there was distinct shearing set in the former, but not in the latter. For the batten-plate columns the shearing distortion and set were about twice those of the latticed columns. Under eccentric load the columns withstood a larger calculated edge stress in the weak direction than in the strong direction; however, in all cases the edge stresses were well above the yield-point of the material as determined in specimen tensile tests, the difference being most marked for short columns. Determinations of the initial eccentricity of columns as arrived at by careful centering of the columns with the use of extensometers on all edges showed that these effective eccentricities were roughly equal to the departure of the column from straightness; the eccentricities due to rolling irregularities were negligible.

Tests of columns in bending as beams showed considerably greater flexibility of the latticed columns in the direction of their lattice planes than in the other direction, indicating that the effective modulus of elasticity used in Euler formula calculations and the like must be taken at a lower value in the direction of the lattice than in the other.

River Flood Data—N. C. Grover, reporting as chairman of the committee on flood protection data, reviewed at some length the existing situation as to knowledge of frequency, magnitude and hydrographic history of river floods. Very extensive data exist, but in uncollated and unanalyzed form, and much of them scattered in many places. Compilation of maximum flood records has been carried far, most recently by C. S. Jarvis, but frequency and volume information has not been compiled or analyzed. It will be necessary to retain an engineer to carry out this work. Pending its completion, all flood studies and protective work in the country are done at serious disadvantage.

Irrigation Hydraulics—Recent tests of flume transitions by Thayer and Yates showed efficiencies of 93 to 97 per cent at contraction, and 79 to 88 per cent at expansion. These figures and a bibliography on silting of reservoirs were presented by Chairman D. C. Henny for the committee on irrigation hydraulics. He reported that work is being done on evaporation (at Fort Collins, Albuquerque, Orland and San Dieguito); on uplift under dams (at five dams of the Bureau of Reclamation); on siphon spillway losses; on scouring below dams; on flume meters; and on side channel spillways.

Arch Tests—During the past year the committee on concrete and reinforced-concrete arches (Prof. C. T. Morris, chairman) has worked on skew arches and on narrow reinforced-concrete arch ribs, with important results.

Prof. George E. Beggs at Princeton University completed the first series of tests to determine the reaction contours (two-dimensional influence lines) for a 30-deg. skew arch of ratio of width to span 13½ to 21. The test was made on a hard rubber model 21 in. in span, with

the aid of the reciprocal principle. Various definite shifts and rotations of one abutment were produced, and the vertical movement of a large number of points on the arch was measured by sensitive dial gages. The results give a very precise picture of the relation between load on the arch to the several end reactions and moments. The tests are to be continued on narrower arches of the same skew and on corresponding arches of 45-deg. skew.

At the University of Illinois Prof. W. M. Wilson tested several reinforced-concrete arch ribs 17½ ft. in span, 5 in. thick at the crown, mounted so that the reaction, arch thrust and end moment could be weighed, and the abutments at the same time adjusted to true position. The primary purpose was to determine the influence of width of rib upon the buckling tendency, the value of hooping, the agreement of measured reactions with calculated values, and the agreement of arch strength with the strength of concrete in control cylinders. It was found that hooping had no value. Strength of the arches agreed with the strength of the controlled cylinders. The measured reactions agreed closely with those computed with due allowance for rib shortening. Arch ribs 3¼ and 4½ in. wide showed, respectively, buckling failure and incipient buckling; ribs 6¼ and 8 in. wide gave pure compression failures. In the series of four ribs the average crown thrusts at failure were 3,770 to 5,000 lb. per sq.in.

This work is to be continued with study of (1) partial loading, and (2) the effect of spandrel columns and decks cast integrally with the ribs. The latter work will be an experimental check on the recently developed view that arch ribs with integral superstructure act as composite structures, the stresses in the superstructure affecting the rib stresses in an important way.

Construction Division

University training of men for the construction industry was discussed at a well-attended session of the construction division. Under the active chairmanship of Dean H. J. Hughes the discussion and two formal papers filled full the two-hour meeting and drew opinion from both constructors and from teachers of engineering. A paper by A. P. Greensfelder, Fruin-Colnon Contracting Co., set forth the chief requirement of the construction industry from the university as men—robust, virile men. The training should be designed to equip these men not only with the mathematics, physics, mechanics and knowledge of materials requisite for technical efficiency but to bear down hard on initiative, leadership, economic sense, ability to observe, ability to express thought, integrity and capacity for fellowship. C. R. Gow, construction engineer, asked for more rigid selection and sifting of engineering students to get those adapted to construction and then heavy pressure on training for leadership and in acute observation and clear and precise expression. L. C. Wason, Aberthaw Construction Co., believed that the most that a college course could give of specific value to construction was the habit of intensive work and the power of concentration. W. J. Barney, Barney-Ahlers Construction Corporation, asked for two years' training along general cultural lines and a two-years' general technical course.

In a written discussion on what the construction industry could do for the university Prof. Anson Marston pointed out that as few engineering students nowadays lack opportunity for employment on graduation — in actuality were being searched out by scouts from other industries, it was the duty of organized construction to make clear the opportunities in their field. At best he thought the college could only well-ground the man in engineering fundamentals and the construction industry must train him in its specific tasks and habits of thought. He felt that constructors were generally lax, compared with other industries, in recognizing their obligations purposefully to supplement the college education with practical education in specific subjects. A number of teachers speaking after Professor Marston's paper was read reiterated the opinion that a general engineering curriculum for three years with specialization in construction in the fourth year was about the best program which the colleges could follow. Also it is the duty of construction to provide vacation work, the extra-faculty lecturers on construction and the post-graduate training employment.

Highway Division

The Highway Division meeting brought out from 50 to 100 attendants. Two major subjects, traffic control for city streets and snow removal from city streets, were scheduled. The first was formally discussed by M. O. Eldridge, director of traffic of Washington, D. C., and Philip D. Hoyt, chairman of the Traffic Board of the Police Department of New York City. Mr. Eldridge said that the electric light traffic signal had come to stay, supplanting in all except the most congested corners the traffic policeman, and at a lower cost. He described the system which has been in use for some time in the city of Washington, particularly on 16th St., where a progressive signal system has been quite effective. Mr. Eldridge said that synchronized lighting is being abandoned for the progressive system because the latter permits travel of the full length of the lighted area at a predetermined rate and also permits shorter intervals of signal shifting. The Chicago system, which is a co-ordinated system of control over a large area, is thought to be excellent but expensive, and generally unwarranted for anything but the most congested centers of our big cities. He discussed to some extent the amber light as an intermediate light, but said in Washington they had concluded that the ideal cycle is green for the desired interval, say 30 to 40 seconds; amber 5 seconds, red for the desired interval, say 30 to 40 seconds, and then green.

Mr. Hoyt described the tremendous complication of the New York, and particularly of the Manhattan, traffic problem. His contention was that the future protection of traffic is an engineering problem but that the current protection is a matter for the Police Department, and seemed to convey the impression that the engineer could give no service to remedy current troubles. Mr. Hoyt was questioned as to the length of interval which is being used in New York City, as to whether it was not too long, but he gave no very satisfactory reply. His attitude seemed to be that there was such a tremendous amount of traffic in New York City that more study was needed to decide whether the interval had anything to do with the added congestion or not. In discussion E. P. Goodrich, New York City, said that a good many cities were installing light signals where they were not necessary.

The discussions on snow removal were by Albert Taylor, commissioner of street cleaning in New York,

and Edward F. Murphy, deputy commissioner of public works, of Boston. Each described in detail the routine operations of his department in snow removal.

Power Division

The greater part of the time of the Power Division at its meeting on Thursday morning was given over to the presentation and discussion of a paper by Ira W. McConnell entitled "The Rôle of the Civil Engineer in Power Development and Distribution." In order to stimulate discussion, Mr. McConnell aggressively championed the work of the civil engineer in power plant construction, especially in the construction of steam power plants where it is generally supposed that the rôle of the civil engineer is a minor one, making assertions which were sure to arouse the champions of the mechanical and electrical engineers. His statements were reinforced by charts and tables showing the percentage of work in both types of power plants done by civil, mechanical and electrical engineers. About 27 per cent of the cost of a modern steam station, he stated, is for work classifiable as civil engineering.

Mr. McConnell was followed by Peter Junkersfeld and George A. Orrok, who had prepared written discussions of his paper. Mr. Junkersfeld took the position that the particular channel of training of the engineer charged with the construction of a modern power station was not important as long as he had a breadth of knowledge and appreciation of the various engineering features which would assure that no one of them would be over-stressed to the detriment of the finished plant. Mr. Orrok took a similar position and deprecated the making of narrow distinctions between the various fields of engineering. In the matter of the civil engineer's contribution to steam power stations, he went on to point out that although superficially the civil engineering field contributed about 27 per cent of the whole, yet it was the mechanical engineer who provided most of the tools and material which he used and the chemist who provided the cement, conditions which prevented making sharp distinctions between the fields of operation. Mr. Orrok showed a table which indicated that between 1900 and 1926 the cost of buildings for modern steam stations had increased from 14.5 per cent to 35.5 whereas the cost of boiler plant had decreased from 45 to 26.6 and of turbines from 35 to 22.5, and electrical equipment had increased from 6 per cent to 15.4 per cent; a comparison which he stated seemed to indicate that the civil engineering side of such work had not progressed to the same extent as had the mechanical development. Also, he said that the gains through improvements in design of mechanical equipment had just about been offset by the loss through the increased cost of the building construction.

At the business session which followed the discussion of Mr. McConnell's paper, the division authorized the executive committee to contribute an amount not to exceed $500 from the division's funds for any feature of the arch dam investigation.

City Planning

Concentration on two subjects was a feature of the meeting of the City Planning Division. The two topics were "Relationship of Architecture to City Planning" and "Consideration of Street Lighting in City Planning."

The first topic was introduced by Ernest J. Russell, an architect of St. Louis and chairman of the local City Planning Commission. Most of the paper was devoted to an outline of city planning. As to the kind of education and training needed for a city planner, Mr. Russel said:

"The proper person to solve these [problems] should be the trained city planner and he needs to be a man with the keenest intellect and of great executive ability. He cannot expect to be an expert in zoning, transportation of all kinds, a manufacturer, a captain of industry, a banker, a real estate man, a professor of economics, a social worker, an engineer, a landscape architect or an architect, but he must be well grounded in the fundamentals of these callings and have a deep appreciation of their relative values. His analytical powers should be developed to the nth degree, for the planner of the future should be able not only to plan nationally but he should be able to visualize the advantages of each locality so that cities may develop their own personalities, not only along economic lines, but spiritual lines as well."

In the course of the discussion Frederick Bigger, an architect of Pittsburgh and executive director of the Citizens Committee on City Plan now functioning in that city, remarked that training as an architect, as an engineer or as a landscape architect does not make a city planner. He stated further that the nebulous condition of city planning today discourages a man trained in any one of the three professions named from taking it up. The architect naturally gives attention to esthetics, among other things, while the tendency of the engineer is to consider safety, economy and durability. The speaker seemed to think that the architect goes more extensively into studies of various possibilities of solving the problem, than does the engineer.

Well toward two hours were occupied with the paper and discussion on street lighting. Most of this time was taken up by C. A. B. Halverson, Jr., designing engineer, Street Lighting Department, General Electric Co., West Lynn, Mass., who, with the aid of two assistants, illustrated some of the principles of street illumination by means of various laboratory models, by large-scale models of lighting standards, lamps and globes, and by lantern slides. One of the features of the demonstration was the exhibit both by models and by lantern slides of the relative values of concrete and darker surfaced pavements as reflectors of lighting.

Sanitary Engineering

Under the topic, "Safe Depth of Wells for Water Supply Near the Sea Coast," Walter E. Spear, department engineer, Board of Water Supply, New York City, gave a comprehensive scientific review of the relations of salt water to the underground waters of Long Island. The paper was illustrated by many diagrams and tables. The second paper on this topic dealt briefly with underground water supplies in Holland and was presented by Charles W. Sherman of Metcalf & Eddy, Boston, Mass.

An historical and descriptive review of "Protective Action of Cement Lining in Iron Pipes" was presented by Harry Y. Carson, research engineer, American Cast Iron Pipe Co., Birmingham, Ala. In his lantern slides, besides showing various examples of cement-lined pipe, Mr. Carson showed two maps of the United States. On the first of these were noted areas where the water is

of such a character as to cause tuberculation, these being confined to a strip of increasing width from the North Atlantic States southward and around into the Gulf States and also a wedge-shaped area in the extreme northwest of the country extending down into northern California. The other map showed areas where pipe is liable to acid attack, due to water drawn from the coal and oil regions. The benefits to be expected from cement linings were brought out in the paper.

Paul Hansen, of Chicago, submitted an appendix to the report of the committee on filter material, in which he reviewed studies of filter sands from the classic pioneer studies of Allen Hazen at the Lawrence Experiment Station to recent work by various organizations. Mr. Hansen thought the time has not yet come to recommend changes in the methods elaborated by Mr. Hazen some thirty years ago. The report of the committee was accepted and the committee continued.

"Iron Removal by the Upward Flow Contact Process," by H. Malcolm Pirnie, of New York City, was read by title.

Structural Division

Foundation Problems and Investigations—Dr. Charles Terzaghi, of Massachusetts Institute of Technology, dealt with the subject "Methods and Possibilities of Foundation Investigation" in an exhaustive paper. He described typical cases of the problem confronting the foundation engineer. These are in part problems of differential settlement as affecting building as a whole, and the corresponding problems as affecting the stresses in continuous mats; and in part problems presented by piledriving resistance and pile bearing values. The author developed at some length the impossibility of making a practical approach to these problems by studies of grain size, moisture content and the like, and finally reduced them to the three factors of rate of compression, permeability (or self-draining quality), and cohesion. In discussing compression he differentiated between the volumetric compression due either to compaction or to forcing out of water, and lateral flow. The influence of these factors upon foundation settlement was brought out by the discussion of a number of practical cases. The same factors, in conjunction with friction, were shown to control the relation between driving resistance, pulling resistance and bearing power of piles.

Charles R. Gow, E. P. Goodrich, and J. Albert Holmes briefly discussed the paper. Mr. Goodrich referred to some tests he made a few years ago in which plungers penetrating a bearing surface 4 ft. square showed that greater soil resistance was developed on the diagonals of the square than in the rectangular direction. A brief discussion of the relation of the author's views to foundation problems in Alaska gravels was also given.

Florida Storm Study—Three months ago a committee was organized by the Division to study the structural effects of the Florida hurricane of September 18 and develop any engineering conclusions that might be warranted thereby. H. G. Balcom, chairman, made a brief progress report in which he indicated the fields which the committee will probably cover:

(1) Determination of the wind pressure exerted by the storm.

(2) A standard method for figuring wind stresses in tier building construction.

(3) Standard details best able to resist wind stresses both from the standpoint of stiffness and from that of strength.

(4) A study to determine whether the same requirements for wind should be used for buildings having a low ratio of height to width, as for buildings having a high ratio.

(5) The strength of masonry walls and the bearing they have on wind bracing.

Concerning the study of details and of wall strength his report said:

"As steel has much more elasticity than the ordinary masonry construction, it is necessary that wind connections be not only strong enough to resist the actual wind, but also that they be stiff enough so that in the early stages they will not throw the entire burden on the masonry construction and cause the masonry construction to crack and fail before the steel comes into action. On the Meyer-Kiser Building apparently the masonry performed almost all the work until it started to fail and then the steel came into action. If the connections had been stiffer, even though they had been no stronger, it is possible that the damage would have been minimized greatly.

"The value of masonry walls as wind bracing is worthy of study. This could well include brick walls, combination tile and brick walls, and tile walls. A study of these with and without openings would be of value. It would also be advisable to determine how much a panel could be distorted before the wall ceased to be of value for bracing purposes. This would probably have to be determined by test."

Structural Welding—The active subject of the welding of structural steelwork was discussed in two papers, "Research in Welding" by F. T. Llewellyn, of the United States Steel Corporation, and "Dependability as a Factor in Structural Welding" by H. H. Moss, of the Linde Air Products Company. Mr. Llewellyn pointed out the incomplete character of the information on the strength of welded connections that has been brought out in the past, and outlined the preliminary program of tests which has been set up by the research committee on structural welding organized last year by the American Welding Society. Mr. Moss reviewed experience with the personal factor in welding, and dwelt on the great growth in the supply of trained welders and on the high demand for uniformity and reliability imposed by work in which welding is extensively used, such as oil pipe lines and refining plant equipment. The means available for checking and supervising the quality of welds include visual inspection and specimen testing. He advocated that each welder should be required to make test samples daily as part of his current work, these samples to be tested in part on the job (by bending in a vise) and in part in the laboratory. In summary, he set forth that the elements of variation or uncertainty are no greater in structural welding than in any manufacturing process.

Because of the size of the program and the inability of the society to provide space for an afternoon session, the papers could not be discussed, beyond a brief remark by L. E. Moore on the visual characteristics of a good weld.

Surveying and Mapping Division

With an attendance of 35 to 40, the new Surveying and Mapping Division held a meeting marked by active interest. Five papers were read, four of them on the subject of boundary surveys, by Prof. C. T. Johnston, of the University of Michigan; F. M. Johnson of the General Land Office, H. J. Sherman of Camden, and G. M. Bowers of Richmond; and one on "Topographic Surveys" by W. N. Brown, of Washington. Chairman William Bowie and W. H. Halsey discussed the latter paper briefly.

Sewage from Lower Merion Pumped to Philadelphia System

Automatically-Operated Pumps at Gulley Run Discharge Against 186-Ft. Static Head —Tests of Force Main

By Francis S. Friel
Of Albright & Mebus, Consulting Engineers, Philadelphia, Pa.

THE design and construction of a sewerage system for the Gulley Run district, a suburb of Philadelphia, completed in 1925, presented some unusual engineering features which included: The selection of two centrifugal pumps, each to discharge 450 g.p.m. of screened sewage against a static head of 186 ft.; the design of a pumping station to accommodate the electrically-driven horizontal compound pumps with automatic control; the construction of a pumping station in a location where the ground water level was 9 ft. above the bottom of the pump room; the successful construction of the sewer system, in a continuous wet ditch, with a negligible quantity of leakage; the testing of the cast-iron force main to determine tightness; and the restoration of water to a spring, the supply of which was cut off during the sewer construction.

Lower Merion Township is a high-class suburban district, located adjacent to the city of Philadelphia. For the most part it lies in the watershed of the Schuylkill River, which furnishes part of the Philadelphia water supply. To protect this supply from pollution, a policy established twenty-five years ago was to pump the sewage to a point where it would drain by gravity into the Philadelphia sewers, thus eliminating every possibility of river contamination from the township.

Lower Merion is subdivided into numerous small watersheds. When the sewer system was started, in 1904, two pumping stations were constructed. In 1915 another one was installed. The three stations now handle the sewage from Ardmore, Bryn Mawr, Cynwyd, Rosemont and Haverford.

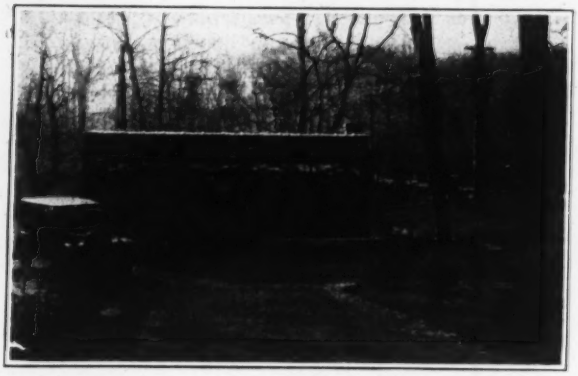
In 1925, due to an extensive real estate development in the area tributary to a small stream known as Gulley Run, it was imperative that sanitary sewers be provided to drain this district. The problem of disposing of the sewage was studied to determine whether the sewage should be pumped or treated. After a thorough investigation it was decided to pump, because of the undesirability of locating a disposal plant in a residential section and the excessive cost of running a trunk sewer an additional two miles to a desirable site. Furthermore, the treatment required would have been of the highest degree. A station was therefore planned and built in a reclaimed lowland and the sewage pumped to a point where it would drain by gravity into the Philadelphia system. Every effort was exerted to beautify the one-acre plot at the pumping station and make it a show place in the community.

Pumping Station—The Gulley Run station comprises a screen chamber, a wet well with a capacity of 8,900 gal., and a pump room. The screen chamber is located outside the pumping station and is equipped with an inclined bar screen having 2-in. clear openings. Two valved lines connect this chamber with the wet well. The wet well is divided into two compartments and has a sluice gate built in the division wall to facilitate flexibility in operation. Normally the sluice gate and the valves on the influent lines are open. Twice weekly each compartment in the wet well is pumped out, and any solids which may have settled are washed to the suction pit by means of a fire hose. However, due to the slope of the floor and the short retention period, practically no settlement has been found.

To operate the plant automatically, the pump room, located adjacent to the wet well, was so constructed that the pumps would have a positive suction. The bottom of the pit was 9 ft. below the ground water level and great care was necessary in order to obtain a thoroughly watertight and damp-proof job. To accomplish this, three-ply membrane waterproofing was placed on the entire outside of the structure. It was done by first pouring a 6-in. slab of concrete and upon it placing the waterproofing. The layers of felt were flashed up around the side forms in order that they might interlace with the side wall waterproofing. The floor slab and the side walls were then poured and after the concrete had thoroughly set the felt was spliced with that previously laid, and applied to the vertical side walls. The backfill was made with selected earth and was carefully tamped. Not the slightest trace of a leak has appeared in the floor or walls of the structure.

The automatic control apparatus is located on a balcony surrounding the pump pit. The balcony is at the same elevation as the first floor. A movable two-ton crane is provided to facilitate the removal of the pumps or motors from the pit.

The grounds were planted with rhododendrons, laurel,

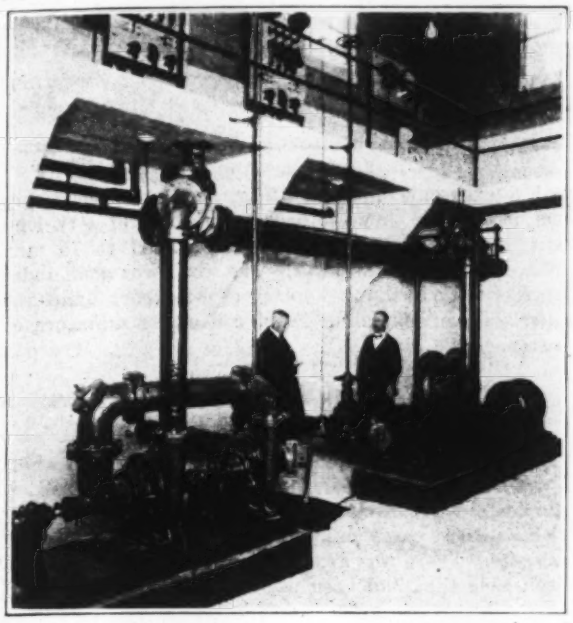


GULLEY RUN SEWAGE PUMPING STATION

and other flowering shrubs, and hemlocks and English ivy. A penetration macadam driveway was built leading from the main road to the structure, and gravel walks were laid within the grounds. A chain link fence, 5 ft. high, painted olive green, encloses the property. At each panel in the fence, trailing clematis was planted. These climbers will form a wall of flowers when they are fully grown.

The cost of the pumping station complete, including the grading, planting, seeding, sodding and fence, was $20,434.

Mechanical Equipment—To pump 450 g.p.m. against the unusual static head of 186 ft., it was found advisable to use duplicate 4-in. horizontal compound centrifugal pumps operated in series. The two units are especially designed for handling sewage, and consist of single side suction pumps with open cast-iron impellers. Adjustable chilled iron liner plates are provided within the casing to facilitate adjustment and to maintain



INTERIOR VIEW OF GULLEY RUN SEWAGE PUMPING STATION, LOWER MERION TOWNSHIP, PA.

efficiency. Each outfit is equipped with a solid steel shaft on which are mounted the two impellers and which extends through the two pump casings of the compound unit. A rubber bushed pin type of flexible coupling connects the motor to the pumping unit. Beneath each complete outfit there is a cast-iron bed plate, with a rim around the outer edge, which is connected with a drainage sump. The ball thrust bearings are oil lubricated and oil cooled. The operating speed of the pump is 1,750 r.p.m. Under a series of tests, each unit discharged sewage at the rate of 485 g.p.m. and the efficiency was found to be 63.5 per cent.

The motors are 50-hp., 2-phase, 60-cycle, 220-volt, constant speed, 40-deg., squirrel cage induction motors. Each is connected with an automatic control apparatus of the transformer type. This equipment provides overload and phase failure protection, and is operated from floats in the wet well, which automatically start and stop the motors when the suction level reaches a predetermined maximum or minimum. The two float switches are arranged at slightly different levels so that either pump may be given the lead. To obtain knowledge of the quantity of sewage pumped from this district and to check the operation of the pumps, a Bristol gage, which records the pressure, time, and period of pumping, was installed. The cost of labor to operate the Gulley Run station has been cut to a minimum by the existence of the remote control apparatus. The operating engineer visits the plant twice daily.

The first cost of the mechanical equipment was $6,943.

Sewer System—The sanitary sewer system built in the Gulley Run district has a total length of 5.2 miles, exclusive of the house connections. The sewer ranges in size from 8 to 15 in. In dry trenching the sewer was laid of vitrified pipe with cement joints. The greater part of the system, however, was built in wet ground and rock, in which case vitrified pipe was laid with cement joints in a concrete cradle, encasing one-half of the pipe. In certain sections where the ground water was extremely high, bituminous joints were used. All creek crossings were built of cast-iron pipe with lead joints. Great care was exercised to construct a system that would admit a minimum quantity of ground water. The final test showed the total leakage in the entire system to be 3.5 g.p.m., or at the rate of 136 gal. per mile per day per inch diameter of pipe.

The construction of the sewers in wet trenching was carried out by excavating 6 in. deeper than the flow line of the pipe and pouring a 1:2½:5 mix concrete base. This foundation was allowed to set for 24 hr. before the vitrified pipe, with 1:1 cement joints, was laid. The lower half of the pipe was then encased in concrete.

A section of the system was constructed in a highway adjacent to a large estate, which obtained its water supply from a spring. The spring house was located 50 ft. from the sewer trench. When the ditch was dug the ground water was diverted to the trench with the result that the spring dried up. It was restored by constructing a concrete headwall across the ditch, the top of which was at a greater elevation than the level of the water in the spring house. To handle the ground water during the construction of the headwall, a 3-in. threaded and capped pipe was inserted at the trench bottom. After the concrete had thoroughly set, the pipe was capped and the water rose to its former level in the spring house. To prevent a possible pollution of this water supply from the sewer, cast-iron pipe was used from the dam to a point considerably beyond the intersection of the sewer and the water level in the spring house.

Cast-Iron Force Main—The 8-in. cast-iron force main was laid on a shelf cut in the same trench in which the sewer was constructed. Due to the high pressure to which the force main would be subjected, the specifications required the pipe to be tested before the trench was backfilled. The tests were carried out by filling the force main with water, exhausting the air, and plugging and tapping the upper or bell end of the pipe. By means of a hand pump with a check valve and gage, the pipe line was put under pressure. The quantity of water pumped into the line was measured for each 5-lb. increase in pressure from zero up to 100 lb. The time was then taken for the pressure to drop between the 5-lb. increment and the results converted into gallons leakage per inch diameter per 1,000 ft. of pipe. The average of a series of tests showed the leakage to be 17 gal. per 24 hours per inch diameter per 1,000 ft. of pipe, when under a pressure of 80 lb. These results were checked by pumping directly into the pipe with the hand pump, maintaining an 80-lb. pressure for a period of one hour, and measuring the quantity of water pumped. Intermediate readings were taken at periods of five minutes, and a plotted curve, indicated by a straight line, showed the leakage was practically at a uniform rate.

Assessing cost—The cost of constructing the pumping station and force main was borne by the township, while the cost of the sewers was assessed against the property owners. Corner properties were exempt 100 ft. on the long side, this being paid by the township, together with the cost of street intersections. The assessment per front foot of property was $2.29. Eighty-nine per cent of the sewer cost was recovered.

Engineering—The work was in general charge of Albright & Mebus, consulting engineers, Philadelphia, with the writer in direct charge.

From Job and Office

Hints That Cut Cost and Time for the Contractor and Engineer

Cost of Cutting Cast-Iron Pipe by Oxy-Acetylene Flame

By Scott Keith
With Metcalf & Eddy, Consulting Engineers, Boston, Mass.

THE following data on the cost of cutting cast-iron pipe by means of oxy-acetylene flame were obtained during December, 1926, on the construction of a grit chamber at the sewage disposal plant at Fitchburg, Mass.

The concrete grit chamber was built with the inlet and outlet ends poured surrounding an existing 30-in.

CUTTING CAST-IRON PIPE BY OXY-ACETYLENE FLAME

Class B cast-iron pipe. It was necessary, therefore, to cut the cast-iron pipe in order to connect the chamber to the influent pipe running to the disposal plant and to bypass the sewage during the time connections were made. Three circumferential cuts in the pipe were also required to set a 30-in. gate valve on the cast-iron pipe line. A total of 69 lin.ft. of cut was required.

The following cost data were obtained:

	Total Cost	Cost per Lin.Ft. of Cut
1,360 cu.ft. of oxygen at $0.02	$27.20	$0.39
825 cu.ft. of acetylene at $0.04	33.00	.48
Labor and supervision—38 hr. at $1.50	57.00	.83
Trucking—3½ hr. at $1.75	6.12	.09
Total cost of materials	60.20	.87
Total cost of labor and trucking	63.12	.92
Total cost	$123.32	$1.79

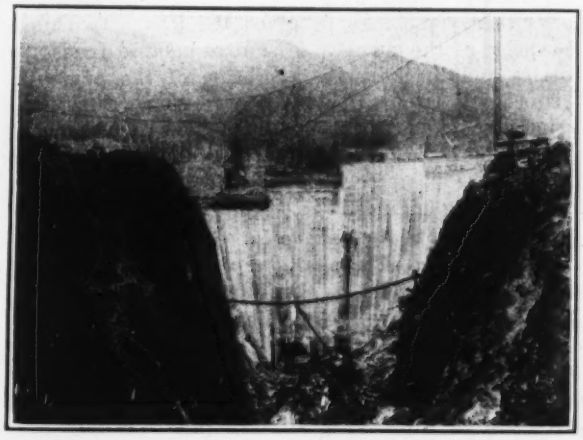
It was found by the burner operator that the initial cuts in the cast-iron were facilitated by pricking through the tar coating and into clean metal of the pipe with a prick punch. For cutting, a broad-tipped burner was used. The time required to make a cut 1 ft. long ranged from about 30 min. at the start to 15 min. toward the end of the work. The work was done under contract with Philip J. Keating of Fitchburg under the supervision of Metcalf & Eddy, consulting engineers, of Boston.

Ten-Inch Wood Stave Pipe Line Has Suspended Span 275 Ft. Long

IN THE construction of the Lake Cushman dam which was recently built for the city of Tacoma, Wash., it was desired to convey a water supply across the canyon with which to carry on sluicing operations at the spillway site. There was available on the job a reel of 1-in. steel cable that had been used for other purposes and was no longer needed. A double line of this cable was passed across the canyon, pulled up with a steam winch with equal tension in both lines and made fast on both sides of the gorge. Transverse wooden ties 3 ft. long were placed on top of the cables and lashed to them with tie wires, the spacing between ties being about 2 ft. A 10-in. wood-stave water main was then served out along the bridge and supported directly on the cross-ties.

When connections to the 10-in. line had been made on both ends it was put under a pressure that amounted to about 175 lb. per sq.in. at the center of the span. The line was used for several months without developing any notable leaks. Although no exact observations were made it is reported that the sag in the span did not increase much when the pipe line was filled and it is believed that the excess strength of the cable over its load was sufficient to hold the line rigid enough to prevent sagging that might have caused leaks.

When the pipe line was put on the cable a makeshift walkway consisting of a line of 2x6-in. planks on either side of the pipe was placed for the use of workmen. This walkway was left in place after the completion of the span and during the time the pipe line was in service workmen frequently crossed on this walkway by



TEN-INCH WOOD STAVE WATER MAIN AT CUSHMAN DAM

straddling the pipe with one foot on the plank on either side of the pipe line.

The design and construction of the Cushman power project is being carried out under the direction of J. L. Stannard, chief engineer.

Plumbing Structural Steel on Tall Building in Columbus

By Roger L. Waring
Supt., C. Howard Crane, Architect, Detroit, Mich.

In erecting the steel framework of the American Insurance Building at Columbus, Ohio, extra precaution was taken to make it plumb, on account of the

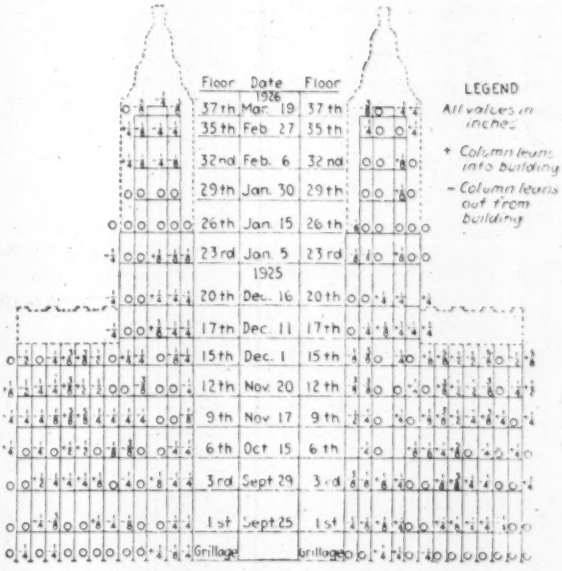


FIG. 1—VARIATION FROM PERPENDICULAR OF EACH COLUMN

height of the building. At this time it was not known that the floor and other construction would necessarily lag behind the erection owing to changes in design.

The usual method for plumbing steel is to use plumb bob and guys for adjusting each tier of columns plumb before starting the riveting of this tier and the setting of the next. In this case the results were checked with transit in every case. To get the steel exactly plumb and keep it so necessitated a certain amount of reaming, but aside from this the erection went forward with the same rapidity as in any other building.

Although the lot was not exactly right-angular it was only a few degrees off, so that it was possible to make the building design right-angular with the loss of only about 3 in. in its length. Therefore all the column centers were at 90 deg.

A line was first established along each of the two fronts at a distance of 2 ft. from the Broad St. and Front St. building lines respectively. The building, by the way, covers a quarter square bordered by Broad, Front, Lynn and Wall Sts. When these two lines had been established, level marks were made opposite where the transit was to set, about 500 ft. beyond the building on the opposite end from the set-up. For instance the transit was set up on this parallel line in Broad St. at a point about 30 ft. east of the building; the level mark used to line the transit was on the Broad St. bridge 500 ft. west of the building or 718 ft. from the set-up.

The set-up being made, the particular tier of columns which had just been placed and plumbed with a bob was checked and the results tabulated. Those columns that the transit showed to be more than ¼ in. out of plumb were readjusted by the steel foreman and the check repeated. When all columns had been thus brought within the required limits of accuracy the results of the tabulation of the tier were given to the steel foreman for his guidance in the plumbing of the next tier.

All the outside columns along Front St. and along Broad St. were plumbed in this way, but no interior columns, as a transit could not be trained on these and as floorbeams and plumb bob could be relied upon to keep them plumb enough.

Using the tabulations of each tier, the foreman could be guided in plumbing the next tier. If the

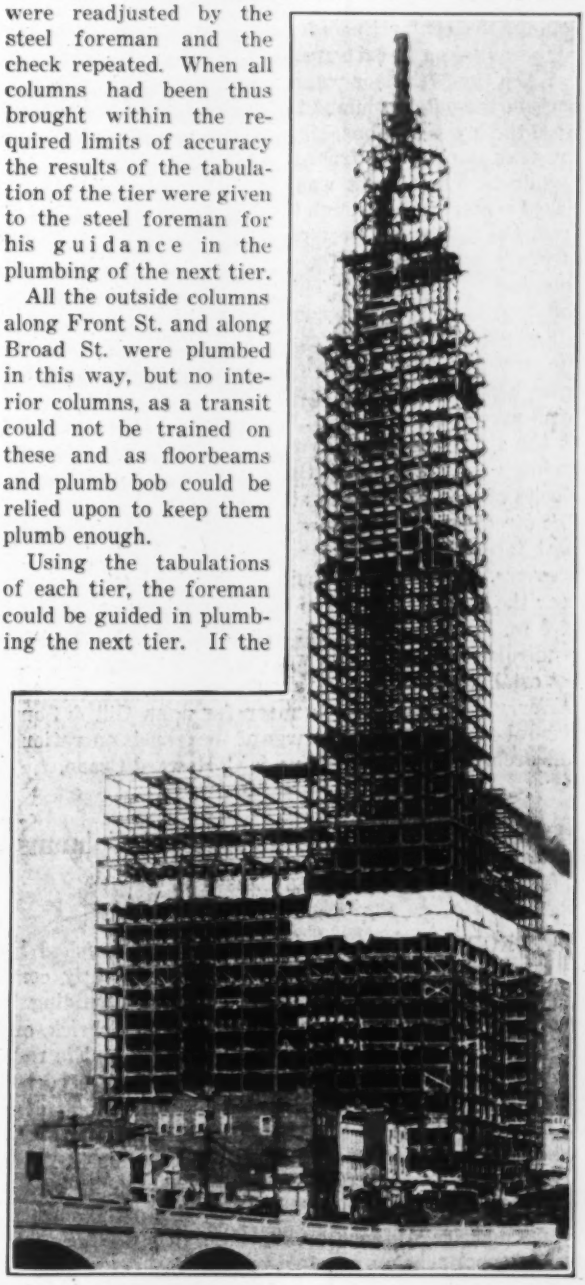


FIG. 2—STEEL FRAMEWORK OF AMERICAN INSURANCE UNION BUILDING AT COLUMBUS

data showed column 3 at the sixth floor to read —¼ in., it meant that this column leaned ¼ in. inward and the next section of this column would be plumbed so that it would lean outward into the street the same amount.

The picture Fig. 2 is a combination of two photographs taken at different periods during the construction progress and is used here so that the entire steel framework may be shown. The schedule Fig. 1 shows the variation from perpendicular of each column taken at each intersection as a result of the transit readings

above described. It is arranged so that each reading will appear in the schedule in the same relative position as that actually taken on each building front.

Since the tiers were three stories in height each third-story level of each column was treated in this way. Because of the irregularities in the steel shapes due to rolling, the center line of the column rather than the edge was taken in each reading.

When the 37th floor was reached, on account of a set-back in the outer columns they could not be plumbed as were the lower sections, since it was impossible to train the transit on them from the old level so close to the building. The transit was therefore set up on established center lines through the tower and readings made from the south and west points of the spandrel beams carefully established on these center lines at each column intersection floor line. This method of procedure was followed from the 37th floor to the top.

Several wind storms occurred during the spring while the steel was being erected. It is interesting to see just what happened in one of these storms. On Feb. 25 the wind attained a velocity of 44 miles an hour. The steel at the time was in place to the 35th floor; the floor arches were in place to the 10th floor. This left 25 stories of steel framework standing without floor arches. The direction of the wind was from the west so that the west face of the tower received the full effect of this pressure. When the transit was trained on the 35th floor the steel was found to have a maximum movement of $\frac{3}{4}$ in. from the perpendicular. The swing from perpendicular and back again was very slow; its period was not established but it took about a minute.

Harry Wismar, civil engineer for John Gill & Sons, general contractors, had charge of the transit operations. The architect for the building is C. Howard Crane.

Front-Wall Arch Abuts Against Columns

BY CHARLES CARSWELL
Philadelphia, Pa.

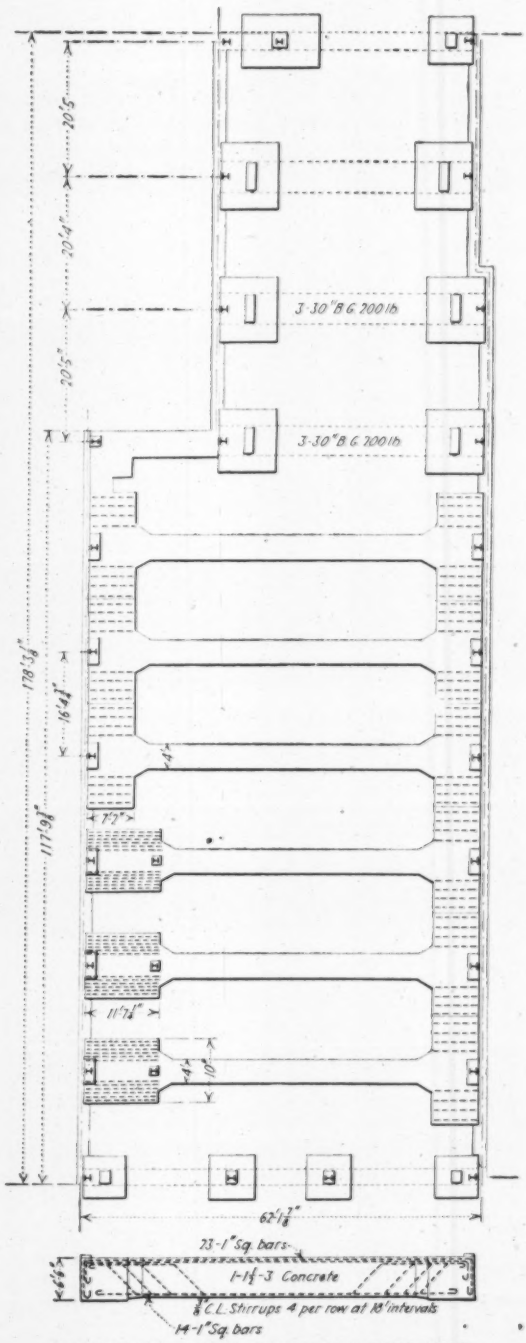
A PROBLEM of arch construction was handled by unusual means in a store building recently completed in Philadelphia. In the front of the building it was desired to have a wide arch of stone and brick, extending from the third floor level to the roof. Tie rods across the front of the building could not be used because of architectural requirements, and the wall piers at the sides of the arch were not wide enough to resist the arch thrust. Therefore the steel columns in these piers have been made to serve as arch abutments by aid of a tie above the crown of the arch; the columns act as beams and are stiffened by kneebraces connecting them to the upper tension member.

The columns are built up of two 18-in. channels reinforced by a $17\frac{1}{2}$ x $\frac{1}{2}$-in. web plate 14 ft. long and two 10 x $\frac{1}{2}$-in. cover plates 20 ft. long at the portions of the columns subjected to the greatest bending moment. The horizontal tie above the arch is made up of two 18-in. channels; the kneebraces are each two 8 x $\frac{3}{4}$-in. flats.

In the same building cantilever framing had to be used, as the footings were constructed entirely inside the basement walls and the basement columns were centered on them, while the columns above the first floor were in the walls, or 16 ft. farther out. The first-floor girders extend beyond the basement columns as cantilevers and carry the columns of the upper floors and the roof.

From Job and Office

Hints That Cut Cost and Time



DESIGN FOR ARCH FOR STORE BUILDING

carry the columns of the upper floors and roof construction.

The building, a three-story store designed for a future fourth floor, is located at 5611 North Fifth St. It was built for the Rosenfeld Department Store. Edwin L. Rothschild was architect and A. P. Valentine, Jr., consulting engineer.

From Job and Office

For Contractor and Engineer

Securing Steel Forms Over Old Paving on Boston Post Road Widening

By S. P. Sears
Superintendent, C. W. Blakeslee & Sons, Contractors, New Haven, Conn.

THE construction work on widening six miles of the Boston Post Road between New Haven and New York has involved some interesting problems. This is a 36-ft. pavement of a prevailing thickness of slab of 9 in.

For about four miles a center strip of new concrete 18 ft. 3 in. wide and averaging about 6 in. in thickness was laid over an old 18-ft. concrete pavement, the extra 3 in. of width being found necessary to secure a good line and firm bearing for the steel forms. Short extension plates were made for the finishing machine frame to cover this extra width. In a few places minor changes in alignment, particularly on curves, brought one form line on top of the old concrete pavement.

Our first method of holding the steel forms true to line was to drill a hole through the old pavement with a jack hammer for each form pin. This plan did not work out to give a satisfactory line unless the holes were laid out with considerable precision and also proved too slow and costly. The following scheme overcame these difficulties:

About 200 of 1 x 4-in. rough boards were secured of assorted lengths from 2 to 8 ft. as needed. In both ends of these strips holes were bored $\frac{1}{8}$ in. larger than the diameter of the form pins. In one end, the edge of the hole was bored about $\frac{3}{4}$ in. from the end of the board (to clear the form) and the other bored near the opposite end at random.

These strips were put in to serve as braces for the forms. The lengths were so selected and placed that the hole-at-random end would fall outside of the old pavement when the forms were properly aligned. The braces were fastened to the forms by a false stake pin inserted through the hole-in-brace and also the pin socket in the forms. (Six-inch rivets of the same size as the form pins are best for the false pins.)

As fast as forms were aligned the regular form pins were driven through the outer hole into the ground. These braces made the forms as rigid as when normally used. Where wood forms were required the same braces were used but nailed to the forms. Wood forms were necessary where the depth of pavement was less than 8 in. and were made from 2 and 3-in. plank as follows:

For 5-in. forms 3 x 5 plank were used on edge; for 6-in. forms 3 x 4 plank on edge spiked on top of a 2 x 6 flat (making an L shaped section) were employed; and for 7-in. plank 3 x 5s on edge nailed to 2 x 6s flat were used.

To secure a good grade over the irregular old pavement it was often necessary to insert wooden wedges under the forms at close intervals.

C. W. Blakeslee & Sons of New Haven, Connecticut, were the contractors for this section with Albert D. Blakeslee in charge and the writer superintendent.

Wood Piles Pulled Through Pivot Pier by Steam Hammer After Blasting

By E. D. Clement
President, Salmons Clement Co., Charleston, S. C.

IN DEMOLISHING the old highway bridge across Wappoo Cut near Charleston, S. C., the old pivot pier which supported the swing draw span had to be entirely removed as it was obstructing the new widened south channel. The old pier was a 16-ft. diameter steel cylinder filled with concrete and 18 ft. from top to bottom. It was supported on 20 timber piles which projected up into the concrete about 2 ft. above low water.

The pier was removed as follows: Holes were drilled in the top of the pier at a 45-deg. angle towards the center, 3 ft. apart and on a circle the radius of which was about 6 ft. The holes were loaded with three sticks of dynamite each and the pier blasted. The spoil was removed with an orangepeel bucket operated from a floating derrick and the blasting operation repeated until the supporting piles were exposed for approximately 2 ft. of their lengths.

When this point was reached the top of the concrete was about mean low water. One of the smaller piles was then selected for pulling and holes drilled alongside of it for a depth of 7 ft. A charge of two sticks was placed in each hole and fired. A reversible steam hammer was attached to the pile and the pulling commenced. After about two hours the pile started up and soon reached a point where it could be handled with the load line from the derrick boom. A charge of explosives was then fired in the hole left by the pile and the nearest pile was next pulled and so on until all of the piles were removed. The remaining concrete was taken out with the orangepeel bucket and then the steel casing was hoisted by the derrick. The piles were found to be 45 ft. long and although driven 30 years ago were in perfect condition.

The removal of the old bridge was embodied in the contract for constructing the new span. The contractors were the Salmons Clement Co. of Charleston, S. C.

Job and Office Notes

A Fire in the Formwork for additional "bleacher" seats at a Chicago baseball park on Dec. 23, 1926, is said to have been caused by careless location or handling of salamanders placed to prevent freezing of the fresh concrete. Although the damage in this case was slight, the accident calls attention to the possible danger of having a number of hot stoves in a large area of timber forming and bracing, with loose lumber also lying around.

During the Summers of 1925 and 1926 the Kansas State Highway Commission found that concrete roads, built three or four years previously were "blowing up" badly. The following remedy was applied by the department of maintenance, in charge of W. T. Hole, who writes: "Attributing this to a theoretical growth in concrete due to expansion followed by cracking during construction, we cut 2-in. slots or grooves across the pavement at intervals of from 500 ft. to half a mile, during the spring of 1926, thereby practically eliminating 'blow-ups' during the summer just passed. Many of these slots closed up immediately after they had been cut. The slots are filled with a joint asphalt filler and covered with fine sand or sawdust."

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

Free Professional Service

Sir—I am writing in appreciation of your timely editorial of Dec. 30 entitled "Free Professional Service."

The Buffalo case to which you refer is an extreme, yet it is in direct line with the current attitude of many city engineers and some engineering firms in private practice. From my experience I could cite you many occasions where not only free service is requested and used, but competitive bidding as to engineering salaries is invited, by men who are not only engineers but are active and influential members of the American Society of Civil Engineers. Such practice seems to be directly opposed to Section 4 of the "Code of Ethics" adopted by the society Sept. 2, 1914.

It must be very disconcerting, to say the least, to an earnest young engineer, who, after reading this code, makes up his mind to live up to it, then to be invited by members of recognized position in the profession to break it. Speaking from experience, something seems to boil over in me when in such a case I remonstrate that the procedure seems to be contrary to professional ethics and am told, "Oh you do not understand the exigencies of the work." Are the exigencies of engineering work today such that we must abandon the engineer's ethical code? If so, let us admit it.

The young engineer, entering the profession, is asked to violate the code by prominent engineers—to survive, he must. Let us make ethical codes more than decorations. For decorations pretty pink flowers and blue ribbon would be better.

W. N. BROWN,
Civil and Mining Engineer.

Washington, D. C.
Jan. 5, 1927.

Would Put Street Car Tracks Near Curb

Sir—Would it not be a good plan to locate street railway tracks along the sides of the street instead of in the center? It is believed that this plan would expedite street traffic and increase safety. Automobiles would then use the open space between the tracks instead of the spaces between track and curb as at present.

In connection with this suggestion attention is called to the following points, most of which indicate advantages of the proposed arrangement:

(1) Street car passengers would step directly from sidewalk to car without having to cross automobile lanes or even step down to the pavement. No part of the street surface would have to be reserved for safety zones.

(2) Automobiles would proceed without reference to street car stops, which would increase the traffic carrying capacity of the street.

(3) For two automobile traffic spaces, each frequently about one-and-one-half lanes in width, would be substituted one space wide enough to accommodate three lines of traffic.

(4) It would be necessary to prohibit parking at the curb, except very short stops for loading and unloading. There would be a difficulty in case of necessity of longer stops, as for example the loading of furniture vans and large trucks. These matters would have to be very carefully handled to prevent delays to street cars. On streets with single-track street car lines there would seem to be a special gain by the proposed plan, as only one side of the street would be taken up by the track.

(5) To provide a track that is level transversely and close to the curb, street drainage systems would require redesign as to gutters and cross walk culverts. A "dished" street surface with low curbs and center drainage might prove the best arrangement.

(6) Parking space, if considered necessary, could be provided in the center of the street or in the center of the space between track and opposite curb by marking off an 8- or 9-ft. strip for that purpose.

(7) For right-hand right-angle turns of tracks, an expensive cutaway of the sidewalk would be necessary to secure the necessary turning radius.

(8) At any point where, in process of changing to the proposed plan, tracks might have to swing from center to side, crossing automobile traffic, there would be a traffic danger, but not a very serious one as automobiles would cross the route of street cars going in the same direction.

F. S. FOOTE.
Berkeley, Calif.,
Dec. 28, 1926.

High-Strength Concrete for Columns Does Not Permit Higher Steel Stress

Sir—In the article "High Strength Concrete versus Compressive Reinforcement" by M. Hirschthal, *Engineering News-Record*, Dec. 9, 1926, p. 955, the following statement is made: "This leaves little doubt of the economy in designing and specifying high-strength concrete for slabs or beams. The case for columns *is considerably stronger* since the stress allowed in the *steel reinforcement is directly proportional to the stress allowed in the concrete in compression*, thus resulting in an economy of both concrete and steel, and at the same time permitting the use of smaller columns and greater available floor space."

The wording used probably represents only a little looseness of thought or expression, although the same wording might have been selected after consideration of certain of the factors involved. In other words, the statement as made may be either wrong, as it is for the usual case, or it may be technically correct for a special case. It is nevertheless in fundamental error, when the properties of the concrete are considered, instead of being a possible omission or loop-hole in current specifications.

The statement "that the stress allowed in the steel reinforcement is directly proportional to the stress allowed in the concrete" is not in agreement with existing specifications for concrete with strengths under about 3,000 lb. per sq.in. One of the basic assumptions in the design of reinforced concrete is that "the concrete and steel deform equally." This involves the assumption that there is no slipping between the steel and the concrete surrounding it. In compression members, whether columns or the compressive side of beams or girders, the stresses are therefore proportional to the moduli of elasticity of the steel and the concrete. Thus: $n = E_s/E_c = f_s/e \div f_c/e = f_s/f_c$, if e (the unit deformation) be equal for both concrete and steel. From the above, $f_s = nf_c$ and the stress in the steel is therefore n times the stress in the concrete. If n was constant for all concretes, the statement as made would be correct. The fact that n is not constant is doubtless the point which Mr. Hirschthal overlooked.

Although there may be difference of opinion as to how close a relation may exist between the ultimate compressive strength of a concrete and its modulus of elasticity, the experiments of Walker, reported in Lewis Institute Bulletin 5, and of others have established beyond reasonable question that the stronger the concrete the higher its modulus of elasticity. It follows that the stronger the concrete, the lower the value of n.

Both Joint Committees (1916 and 1924) have taken partial account of this recognized relation, although Walker's experiments were published several years after the 1916 Joint Committee Report. Regardless of the particular type of formulas used, all recognized specifications agree, in these essential respects, with the properties of the materials, the mechanics of the problem and the basic assumptions made. For purposes of illustration, therefore, the detailed steel stresses in columns are given in the accompanying table for the three most usual grades of concrete, according to the provisions of the 1924 Joint Committee Report.

The specific values for n are defined in the Report (Section 103) as follows:

Ultimate 28-day compressive strength	n
1,500-2,200 lb. per sq.in.	15
2,200-2,900 lb. per sq.in.	12
2,900 lb. and over	10

It must be recognized that the values of 15, 12 and 10 for n are but convenient steps to define roughly a gradually changing relation. It is not to be supposed that a 2,190-lb. per sq.in. concrete actually has an essentially different value of E than has a 2,210-lb. concrete. Nor are the values of E actually the same for 2,200- and 2,900-lb. concretes. In like manner, the specifications designate but one value of n (i.e., one modulus of elasticity) to be assumed

for all concretes above 2,900 lb. per sq.in. This approximation is sufficiently close for a limited range, but it does not make the E for 4,000- or 5,000-lb. concrete actually equal to that for 2,900-lb. concrete. Thus, according to the wording of the specifications, there would be a greater stress in steel imbedded in 4,000-lb. concrete stressed to its allowable limit than in steel embedded in 2,900- or 3,000-lb. concrete. This apparent lack of disagreement with the letter of the specification does not make the steel carry one more pound of stress. To the present time, mixtures stronger

STEEL STRESSES FOR DIFFERENT STRENGTHS OF CONCRETE ACCORDING TO 1924 JOINT COMMITTEE REPORT

28-Day Strength Concrete f_c'	E_s/Ec n	Spiraled Columns $f_c = 300 \div 10\ 10 \div 4p/f_c'$ p	f_c	$f_s = nf_c$	Tied Columns $f_c = 0.02f_c'$	$f_s = nf_c$
2,000	15	0.01	580	8,700	400	6,000
		.02	660	9,900	400	6,000
		.03	740	11,100		
		.04	820	12,300		
		.05	900	13,500		
		.06	980	14,700		
2,500	12	0.01	650	7,800	500	6,000
		.02	750	9,000	500	6,000
		.03	850	10,200		
		.04	950	11,400		
		.05	1,050	12,600		
		.06	1,150	13,800		
3,000	10	0.01	720	7,200	600	6,000
		.02	840	8,400	600	6,000
		.03	960	9,600		
		.04	1,080	10,800		
		.05	1,200	12,000		
		.06	1,320	13,200		

than 3,000 lb. have been rarely used and the value of $n = 10$ for such mixtures was doubtless considered as covering all probable cases. If the trend were to be toward considerably stronger mixtures, it is probable that lower values for n would or should be specified.

The table shows the general relation very clearly. There is no actual gain in using richer mixture so far as being able to subject the steel to increased stress is concerned. In the table it is noted that the steel stress is identical in tied columns for all three mixtures; in the spiraled columns the steel of the weaker concrete carries the higher unit stress. The value of E for the concrete increases at about the same rate as the ultimate strength and the actual stress in the steel remains about constant regardless of the mixture. Neither specifications nor their interpretation can alter this situation.

It should not be implied from the above that richer mixtures are opposed. They are often to be desired as a means of reducing size and weight of members or to obtain high-strength concrete at early age. The matter of shrinkage and shrinkage stresses should not, however, be overlooked. It is probably true that the shrinkage is greater for rich mixtures than for leaner ones.

HERBERT J. GILKEY,
Associate Professor of Civil Engineering,
University of Colorado.

Boulder, Colo.,
Dec. 27, 1926.

Sir—In reply to Mr. Herbert J. Gilkey's comments and criticism of the writer's article on "Higher Strength Concrete" published in your issue of Dec. 9th of last year, will you please note the following: In the second paragraph of the article the statement is made "The modulus of elasticity of this (the higher strength) concrete may be assumed as *one-tenth* of that of steel as against *one-fifteenth* in the leaner mixture."

This is fairly good evidence that this point was not overlooked. Besides one term of an equation may vary either *directly* or *inversely* with another term regardless of the factors modifying such terms. The writer is perfectly aware of Mr. Walters' experiments on the moduli of elasticity of various concretes and has been searching for all available data both from the Lewis Institute and the Cement Association on that subject. It is the writer's opinion that the moduli of various strength concretes do not take sudden "jumps" but that they vary *directly* with the strength. If the various tests are plotted it is found that the moduli are not very far from 1,000 times the ultimate strength of the concrete.

The column actually considered by the writer but not discussed in the above mentioned article because the information would take too much space in a discussion of precast slabs, were heavily reinforced spiral columns of over 4-ft. diameter; the important point being the reduction of the diameter in the first place, and the economy being an added factor.

Mr. Gilkey may perhaps not be informed of the fact that almost universal criticism has been leveled at the Joint Committees' column recommendations. The column formula [$f_c = 300$ plus (0.10 plus $4p/f_c$] is based on $.25f_c'$ for 2,000-lb. concrete for which without vertical or other reinforcement there results 500 lb. per sq.in. for f_c; but for 3,000-lb. concrete with the same condition $f_c = 600$ lb. per sq.in. while .25 would be 750 lb. and so on up the scale. Moreover the Joint Committee based its increase of compressive strength in concrete on the percentage of longitudinal reinforcement, whereas there is absolutely no doubt that the compressive strength of the concrete inside the core is entirely a factor of the percentage of the *spiral* reinforcement. The writer was firmly convinced of this fact from his presence at tests of full-sized spirally reinforced columns. The formula for the design of spiral columns used in this office is one developed by the writer in which "f_c" depends on the spiral reinforcement.

However, even if the column reinforcement were based on the Joint Committee recommendations the reinforcement in the 2,000-lb. concrete would have an allowable stress in the steel of 6,000 lb. per sq.in., while that in the 3,500-lb. concrete would have 7,000 lb. per sq.in. allowed in the steel reinforcement. This is not a question of whether the specifications can make the steel take more stress, but of whether it isn't most likely that the higher the concrete is stressed the higher will be steel (which is practically an integral part of the column) be stressed. The writer does not understand Mr. Gilkey's complicated formula for relationship of f_s and f_c. It seems that it could be simply derived from the following:

$$N = \frac{ES}{EC} = \frac{f_s}{f_c} \div \frac{c}{c} = \frac{f_s}{f_c} \quad \text{from which } f_s = nf_c.$$

It seems to the writer that Mr. Gilkey has raised a "straw to knock it down."

M. HIRSCHTHAL,
Concrete Engineer, D.L.&W.R.R.

Hoboken, N. J.,
Jan. 17, 1927.

"To Insure Responsible Contractors"

Sir—Your editorial note of Oct. 28, 1926, entitled "To Insure Responsible Contractors" is interesting and would surprise most of the engineers in this country. In the Public Works Department in India there is an established practice of maintaining lists of approved contractors, and tenders for construction of public works are invited exclusively from those who have gained reputation in contracting practice as evidenced by their names being borne on such lists of "Approved Contractors."

Any contractor applying to be so listed as an "Approved Contractor" invites the chief engineer to make an investigation of the history, reputation, organization and capacity for satisfactory and faithful performancce of work of his firm and if the results of this investigation are satisfactory, his name is listed as an approved contractor. If on the other hand it is found that an "approved contractor" to meet expectations, his name is removed from the list.

This practice, it is obvious, is better than the one which requires every engineer who is consulted for a job to hold an inquiry into the organization and capacity of each contractor bidding for it.

As an alternative to the Indian practice, outlined above, membership in an organization like the Associated General Contractors could be raised to a high standard so as to represent on the part of a member, a contracting organization of a high order, possessing equipment of an up-to-date character, efficient and trained personnel, and adequate financial resources, even as membership in the more notable engineering societies of the world's advanced countries is a hall mark of the high-grade professional engineer.

H. J. AJWANI,
Assistant Engineer,
Lloyd Barrage and Canals Construction.

Jacobabad, Sind, India,
Dec. 6, 1926.

News of the Week

Current Events in the Civil Engineering and Contracting Fields

Road Builders' Association Formulates Budget

Fiscal Committee Recommends Plan for 1928 Expenditures—To Promote Safety

At one of the meetings of the American Road Builders' Association in Chicago, Jan. 10-13, the fiscal committee, appointed at the last meeting of the board, presented a report which includes a budget for next year's work. This report says: "In past years the fiscal policy (if it can be called such) of the American Road Builders' Association has been confined almost entirely to the holding of the convention and road show. Taking into consideration the standing, influence, and responsibility of the association, and the possibilities which can be found within its means, the committee has in mind the feeling expressed by its board of directors—that the association must do more than run a convention and a machinery exposition in order to justify its future existence, present organization, and commitments."

Referring to the motion calling for the creation of a fiscal policy, the committee reminds the board that it was instructed to submit "a plan in January for final action in May." The report continues: "It seems almost impossible to make an appreciable start without drawing upon our surplus. This perhaps is neither sound planning nor financing, for at present no income is in sight beyond the membership dues and the annual earnings of the road show. But we emphatically point out that we must have confidence in our ability to obtain results which will command sufficient attention to make possible such added income, through contributions and other means, as will permit the continuance of the plans outlined. If after trial the results are unsuccessful, then has the American Road Builders' Association the right to continue with a fixed yearly expense such as now exists, having the convention and the road show as its only contribution to industry? Your committee has ventured to plan its budget on the foregoing premise, and has outlined a program in accordance therewith."

The committee then urges the prominent feature in the coming year's activities to be the promotion of highway safety, but leaves the details of this campaign to the executive committee and the business director. They recommend further that a fund be established enabling the association to encourage the visits of selected foreign engineers to this country for the study of American highway methods, and that an appropriation be made for the American Association of State Highway Officials. For all these purposes they submitted the following budget:

Estimated Cash as of March 31, 1927:		
From surplus	$31,300	
From 1927 Road Show and membership dues	42,000	$73,300
Estimated disbursements for the fiscal year ending March 31, 1927 (exclusive of Road Show expenses):		
Salaries for present organization	$22,000	
Office rental	3,600	
Additional stenographic service	2,400	
Stationery, telephone, office supplies, etc	4,000	
Published proceedings 1928 Road Show	2,800	
Assistance to foreign engineers	2,500	
Assistance to American Association of State Highway Officials	2,500	
Safety campaign	8,000	47,800
Estimated cash surplus as of March 31, 1928		25,500
(This item does not include earnings of 1928 Road Show nor membership dues).		
Your committee recommends a minimum cash reserve of		10,000

The report then says: "In view of the resolution passed by the Board of Directors at its meeting in Philadelphia, Oct. 20, 1926, no provision is made in this report for further publishing the Catalog Directory. You will note that we have depleted the 1926 fiscal year surplus, according to this budget, $5,800. Our object in calling this to your attention is to point out that unless we are able to obtain income from additional or outside sources, the surplus remaining at the end of 1927 fiscal year will be depleted, at the present rate of depreciation, in approximately three years."

The report was presented to the meeting, and will be brought up before the board at its meeting in May.

At the time of the convention the Highway Industries Association elected directors as follows:

S. F. Beatty, president of Austin-Western Machinery Corporation, Philip Koehring, the Koehring Co., Lion Gardiner, Lakewood Engineering Co., and Robert Hume, Engineering and Contracting Publishing Co.

New Vehicle Tunnel Proposed for New York City

Bills introduced in the New York Legislature last week provide for building a highway tunnel across the Borough of Manhattan on the line of West 38th St. from 12th Ave. to 1st Ave., and thence under the East River to Borden Ave. in Queens, and under Newtown Creek and Oakland St. to Huron St. in Brooklyn. The bills empower the Board of Estimate and Apportionment to develop a plan for such tunnels and to determine what part of the cost of construction is to be borne by the city at large and what part by the real property of one or more of the boroughs, and to assess the cost correspondingly.

Civil Engineers Conclude Annual Meeting

All Technical Division Meetings Well Attended—Trips to Bridgeport and New Subway

The annual meeting of the American Society of Civil Engineers at New York, a preliminary report of which was given in *Engineering News-Record*, Jan. 20, p. 127, concluded on Jan. 22 with an inspection trip over some of the construction on the new Eighth Ave. subway, New York, including the complicated four-track undercrossing of the present subway at Columbus Circle.

Thursday was given over to meetings of the technical division, three in the morning and four in the afternoon. Reports of these sessions are given on p. 156. In the evening serious matters were put aside while the members and their guests attended the trial of the now well-known engineer and contractor whose engineering designs and contracting methods caused so much amusement at last year's meeting.

Attendance at the technical sessions was very satisfactory, ranging from 35 to 40 at such specialized discussions as that of the surveying and mapping division up to from 250 to 300 at the structural division session.

On Friday, Jan. 21, there was an excursion to Bridgeport, Conn., to visit a number of manufacturing plants, the plant of the Bridgeport Hydraulic Co. (water supply) and the city's sewage-disposal plant. Despite the bad weather, about 165 people went on the trip.

Division Officials

Elections in the nine technical divisions for membership in their executive committees resulted as follows:

City Planning — H. Bartholomew, Morris Knowles, C. W. Leavitt, Stephen Childs, W. W. DeBerard.

Surveying and Mapping—W. Bowie, C. H. Birdseye, C. T. Johnston, R. S. Patton, A. L. Vedder.

Power—N. C. Grover, I. W. McConnell, E. W. Maloney, A. H. Marquardt, E. H. Sargent.

Irrigation—G. M. Bacon, L. E. Bishop, Lynn Crandall, R. I. Meeker, F. H. Tibbetts.

Waterways—J. F. Coleman, Harry Taylor, J. R. Freeman, Edgar Jadwin, W. H. McAlpine.

Highways — A. N. Johnson, H. E. Sargent, H. K. Bishop, H. E. Breed, S. B. Slack.

Construction—W. J. Barney, A. C. Everham, J. P. H. Perry, H. W. Latta, J. E. Sirrine.

Sanitary—S. A. Greeley, A. Marston, C. G. Gillespie, R. B. Morse, R. S. Weston.

Structural — A. E. Lindau, C. E. Chase, G. E. Beggs, P. G. Lang, Jr., F. E. Richart.

In his annual report, Secretary Sea-

bury stated that the past year had been a record one in the matter of membership. The total number of members is now 12,002, 1,033 having been elected during the year. Deducting losses the net increase was 721 members. This is much larger than any previous year but is offset by the small number received in 1925. The number of juniors increased from 321 on Jan. 1, 1926, to 1,125 on Jan. 1, 1927, a gain of 455.

Society finances also have made an excellent showing. General expenses increased from $251,000 for 1925 to $282,000 for 1926, and notwithstanding the payment of $60,000 on the mortgage on the 57th St. property, the year closed with $25,400 in cash and $46,400 in short-term securities as a balance in hand and $77,300 in the various trust funds. As noted in these pages last week the society has made a very advantageous lease of the 57th St. property, extending over three periods of 21 years each with an annual net rental of $52,500 for the first period and annual net rentals for the second and third periods at a rate of 5.5 per cent of the re-appraised value of the property treated as land alone, but in no event to be less than $52,500.

COMMITTEES OF THE BOARD

Appointments on the various committees of the Board of Direction are:

Executive Committee—John F. Stevens, W. T. Chevalier, George S. Davison, Allen Hazen, John C. Hoyt.

Meetings and Publications—Charles Gilman, F. O. Dufour, George J. Ray, C. M. Spofford, Frank M. Williams.

Research—M. S. Ketchum and Thomas H. Wiggin, three years; Arthur N. Talbot and F. E. Turneaure, two years; and G. M. Braune, Anson Marston and F. E. Schmitt, one year.

Public Relations—A. J. Hammond, H. W. Dennis, Robert Ridgway, A. B. Sawyer, E. G. Taber.

Technical Procedure—The president and secretary, the chairmen of the committees on local sections and on research; Charles Gilman and W. T. Chevalier for the Board; and the chairmen of the technical divisions.

Honorary Membership—Robert Ridgway, George S. Davison, John F. Stevens, Allen Hazen, John C. Hoyt, W. L. Huber, Arthur E. Morgan.

Local Sections—H. D. Dewell, T. O. Hatton, D. H. Sawyer.

Student Chapter—G. M. Braune, C. M. Buck, George L. Lucas.

Professional Conduct—W. L. Huber, A. J. Hammond, Charles H. Paul.

Aims and Activities—Charles H. Paul, H. W. Dennis, T. Chalkley Hatton, A. E. Morgan, C. M. Spofford.

Registration—Frank M. Williams, C. M. Buck, J. C. Brillhart, A. R. Raymer, E. G. Taber.

Engineering Lectures

It is stated that the present course of lectures on "Strength and Resistance of Materials" is being given at Detroit by Professor J. A. Van den Broek and not by Professor Henderson, as noted in *Engineering News-Record* of Dec. 30, 1926, p. 1094.

Norfolk & Western Ry. Plan Building 53-Mile Line

As a result of the refusal of the Interstate Commerce Commission to permit the Norfolk & Western Railway Co. to acquire control of the Virginian Ry., the Norfolk & Western, through a subsidiary railway known as the Guyandot & Tug River Railroad Co., has applied to the commission for authority to build a new line to form a connecting link between the Virginian and the Norfolk & Western, together with a proposed loop return line near Bluestone Junction. The proposed new line will extend from a connection with the Virginian at or near Elmore, W. Va., by way of Gilbert to Wharncliffe on the Norfolk & Western in Mingo County. The total length of this line is 53 miles.

Upland Water Supply Proposed for Poughkeepsie, N. Y.

A report on a new source of water supply for Poughkeepsie, N. Y., is being prepared by Thomas F. Lawlor, city engineer, under authorization of the Board of Public Works. Water would be taken from an impounding reservoir to be constructed twelve miles east of the city. Poughkeepsie is now supplied with double-filtered and double-chlorinated water pumped from the Hudson River. The original filtration plant was built over fifty years ago. It and a similar plant built about the same time for Hudson, N. Y., were for a long time the only slow sand filter plants in the United States.

Engineering Fifty Years Ago

From *Engineering News*
Jan. 27, 1877

THE annual meeting of the Poughkeepsie Bridge Co. was held on Jan. 3, when the treasurer made a satisfactory statement in regard to the payment of the first assessment of ten per cent, or $100,000. Mr. Rust, of the American Bridge Co., reported that the preliminary work was being pushed forward rapidly; that one caisson was ready for launching, others were in progress, and that the company expected to build all four of the piers in the channel up to at least 20 ft. above high water before the close of navigation next fall.

Utah Withdraws from Colorado River Compact

By vote of the Utah Legislature, that state has withdrawn from the Colorado River Compact by revoking its approval of the compact. The grounds for this action as presented by Representative Leatherwood in a hearing before the rules committee of the House at Washington are that the rights of Utah to Colorado River water for irrigation and power development would be jeopardized by the passage of the Boulder Canyon Bill, which would leave Arizona free to appropriate water and acquire priority over Utah.

Sharp opposition of view between Utah and other of the upper basin states developed in the hearings before the rules committee. Representatives of Colorado, Wyoming, Nevada and New Mexico supported the Boulder Canyon Bill to the extent at least of urging that the rules committee allow the bill to be brought up for discussion on the floor of the house. The representative of Utah, on the other hand, claimed that any action of the United States could not bind individual states as to their rights to use of the water of the river and asserted that Utah's rights to future use of the water would be protected only if Arizona ratified the Colorado River Compact. He also charged that the bill provides essentially a power development and that "it is unnecessary that there be such a gigantic proposition." He argued that a dam below Boulder Canyon could be built for $15,000,000 which would give complete flood protection.

Chicago Sanitary District Budget is $34,000,000 for 1927

Authorized expenditures of the Sanitary District of Chicago for all its departments during the calendar year 1927 aggregate $34,180,824, according to the published budget. Of this total, $23,919,383 are for the department of engineering, distributed as follows: Engineering services, including engineering, electrical and maintenance and operating divisions, $3,765,683; materials, supplies and equipment, $889,700; construction, $17,275,000. This construction total includes: Buildings, pumping stations and power plants, $464,000; bridges, $1,053,000; locks, dams and channels, $1,067,000; sewers and sewage treatment works, $14,521,000; paving, grounds and electric circuits, $170,000.

Bills Would Give Maryland Funds for Public Works

Indications are that the Maryland General Assembly, now in session at Annapolis, will pass several bills providing for loans to be used for improvements. The bills have been introduced in both houses and as they are administration measures it is expected that they will pass.

One of the bills provides a loan of $4,150,000 for new buildings and other construction work. A general highway construction bill makes provision for a loan of $3,250,000, and another provides for $1,000,000 for bridges.

In addition a bill has been offered to add 1½ cents to the state gasoline tax, the money to be used for the construction of lateral roads, and another for a 1-cent additional gas tax, this money to be used to pay the state's share for the elimination of grade crossings. It is estimated that the state's share to carry out this work would be $10,000,000.

Bill to Set Up New York State Power Authority Presented

Governor Smith's water power bill to create a state power authority was introduced into both houses of the New York State Legislature on Jan. 24. The measure would set up a commission of three members to head a body corporate and politic, perpetual in duration, capable of owning property, borrowing money and making contracts to be known as the New York State Power Authority, such commissioners to receive no salary but to be reimbursed for all their expenses. An appropriation of $100,000 is carried in the bill.

The power authority would first investigate the entire water power situation and report to the legislature of 1928 concerning the practicability of securing development of state-owned power through the power authority or otherwise. It would have power to negotiate with the Canadian government, the federal government, to subpoena and compel the attendance of witnesses.

The bill does not specifically repeal the present water-power licensing statute, but would insert a clause stating that "The provisions of the conservation law and every other law relating to the conservation department or commission, . . . shall, so far as necessary to make this law effective, be deemed to be superseded, and wherever the powers granted herein to the power authorities are deemed to be in conflict with prior provisions of law or are inconsistent therewith, the said prior provisions of law shall be deemed by this act to be modified, or repealed, as the case may be.

New Delaware River Bridge at Philadelphia Planned

Announcement has been made by officials of the Tacony-Palmyra Ferry Co. of plans for the construction of a bridge over the Delaware River at Philadelphia, about eight miles above the new Philadelphia-Camden suspension bridge. For the purpose of constructing the bridge, the Tacony-Palmyra Bridge Co. was chartered June 25, 1926. A bill granting this company authority to construct a bridge was introduced in the Senate in December by Senator Walter E. Edge, New Jersey, and passed by the Senate. A similar bill was introduced in the House by Congressman John J. Connelly, Philadelphia, and was passed on Jan. 14, 1927. The Tacony-Palmyra Bridge Co. has retained as engineers Ralph Modjeski, Frank M. Masters and Clement E. Chase, associate engineers. Borings have been completed at the site and the preliminary report on the project has been submitted to the company, after traffic surveys and design studies covering several months.

It is intended that the bridge shall extend from Levick St. in Philadelphia to a spot known as Eight Mile Point on the New Jersey shore. At this location the distance between pierhead lines of the river is 2,200 ft. The bridge is proposed as a low-level bridge, with a movable span over the river channel. The floor level of the movable span would not be lower than that of the Pennsylvania R.R. bridge, which is located a short distance below the proposed bridge. The cost of the new project is estimated at about $4,000,000.

The proposed bridge will be financed and owned by the Tacony-Palmyra Bridge Co. and will be operated as a toll bridge. The ferry which the bridge will replace carries at the present time about 400,000 vehicles annually.

Bill for Sewage and Industrial Waste Study in California

A bill authorizing the California State Board of Health to engage in research and field study of the disposal of sewage and industrial wastes and to determine "proper methods" for their "treatment and disposal" has been drafted by engineers in that state for introduction in the present session of the legislature. The bill authorizes the board to expend $100,000 for the purpose indicated; to employ such staff as it sees fit; and to appoint an advisory council of five members to consult with on the subject, the board to serve without pay but to have its travelling expenses met when "detailed on work" by the board.

Kansas Water Works Association To Petition A.W.W.A.

The second annual meeting of the Kansas Water Works Association, in connection with which was held the fifth annual three-day school for filter operators and water-works superintendents, showed a substantial increase in attendance over previous years, the total registration being 73. The meetings were held at the University of Kansas, Lawrence, Jan. 17-19. The question of affiliation with the American Water Works Association has been considered for the past two years and this year the Kansas association now having the necessary number of members in the national body passed a resolution to change the name of the organization to the Kansas Section of the A.W.W.A., the latter approving.

The "faculty" of the three-day school was composed of professors in the Kansas University engineering school, prominent water-works men and consulting engineers. High spots on the program were two papers by J. J. Hinman, Jr., associate professor of sanitation, University of Iowa, on "Measurements of the Quality of Water" and "Algae Identification and Control"; a paper by W. Scott Johnson, state sanitary engineer of Missouri on "Highway Sanitation Problems"; a paper on the "Design of Water Distribution Systems" by N. T. Veatch, Jr., of Black & Veatch, consulting engineers, Kansas City; and a paper on "Effective Sewage Chlorination and Possible Cost Reduction" by L. H. Enslow, sanitary engineer, Chlorine Institute, New York. Sufficient time for discussion was allotted to each paper.

B. S. Ulrich, water superintendent, Manhattan, was elected president for 1927, and Ernest L. Boyce, chief engineer, Kansas State Board of Health, secretary-treasurer.

New Jersey Constructors Hold Annual Meeting

The New Jersey Constructors' Association held its annual meeting in Trenton on Jan. 3, at which time the following officers were elected for the coming year: President, John L. LeCompte, of Trenton; vice-president, Pete Staub, of Pitman; secretary, Joseph F. Burke, of Plainfield; and treasurer, A. B. Whelan, of Trenton.

The association has been very active in the past year under the presidency of Graham Van Keuren of Jersey City and the coming year "bids fair to duplicate or surpass the past year for its activities looking toward the betterment of the road construction industry as a whole," says a communication from its secretary. The association now has nearly one hundred active and associate members.

Following the meeting the annual banquet of the association was held at Blooming Grove Farm. Many of the county engineers of the state and most of the department heads of the State Highway Department were present as guests, the latter contingent being led by State Highway Engineer W. G. Sloan.

The newly elected president has been a road builder for the past twenty-five years, during eighteen of which he has been located in Trenton. He is the vice-president of Ross & Whelan Inc., and during his independent operations and since joining the Ross & Whelan Co. he has built a large number of roads throughout the state and in Pennsylvania.

Report Made on Reclamation of New Jersey Marshes

A report as to the best method of procedure looking toward the reclamation of the salt and fresh water marshes and the improvement of adjacent waterways within the New Jersey portion of the Port of New York District, has been made to the New Jersey legislature by the state Board of Commerce and Navigation. The act under which the report was made instructed the board to prepare and present to the legislature a comprehensive plan for the reclamation of these low-lying lands which occupy some 36,500 acres in the port district. However, as the legislature made no appropriation for carrying out the work, the board had only its limited engineering force for the purpose and so was unable to prepare anything other than a preliminary report. It states that to make an adequate survey and report would require an expenditure of $100,000.

The board recommends first the preparation of a detailed plan of the region showing property ownership and present conditions. Upon this plan it proposes that possible schemes be laid out and presented to all the interested bodies and communities for discussion and amplification to provide the basis for the preparation of a final and comprehensive plan. This work should be followed by a study of the legal details and subsequently by the preparation of a plan of financing the project.

Four Millions Appropriated for Poughkeepsie Bridge

An appropriation of $4,000,000 for the completion of the Mid-Hudson bridge, to cross the Hudson River at Poughkeepsie, N. Y., was made by the New York legislature as its first appropriation of the current session. The bridge is being built under the direction of Col. F. S. Greene, state superintendent of public works. Ralph Modjeski and Daniel E. Moran, of New York, are associated as consulting engineers in charge of design and supervision of all construction.

On prior appropriations the east approach has been completed, anchorage pits excavated, anchorage steel placed, and the pits filled with concrete, by Scott Bros. Construction Co., Rome, N. Y. The two main piers of the 1500-ft. suspension span, to be constructed by the open-dredging process, have progressed to the point where the pier cylinders have been built on ways and are ready to be towed to the site as soon as the ice goes out in spring. Blakeslee-Rollins Corporation, Boston, is contractor for the pier work.

Under the appropriation just made, the anchorages will be completed, the towers erected, the cables and suspended structures and floor and sidewalks constructed, completing the bridge. Bids for the superstructure contract have been called for March 9. Construction is to be completed within two years. The total cost of the bridge will be $6,000,000, land cost and west approach highway excluded.

P.C.A. Gives Short Courses on Concrete Mixtures

In order to acquaint engineers, architects and contractors with the method by which concrete is designed for predetermined strength according to the methods developed by Prof. Abrams, the Portland Cement Association, with the co-operation of various engineering societies, has started a series of short courses. The course in Buffalo, given under the auspices of the Buffalo Engineering Society, was given Jan. 20 and 21 and will continue Jan. 27 and 28, and February 2. Under the auspices of the Rochester Engineering Society the course will be given Jan. 24, 25, 31 and Feb. 1 and 3. At Johns Hopkins University it will be given Feb. 14, 16, 18 and 21, and at the Engineering Societies Building in New York City the course will be given Feb. 28, March 1, 3, 7 and 9. A special two-night course will be held at the Syracuse University, Feb. 1 and 2 in connection with the special road course conducted there each year.

Progress on Montreal Bridge

The Montreal-Longueuil bridge, now under construction, will be completed and open to the public in 1930 or 1931, P. L. Pratley, consulting engineer of the firm of Montserrat and Pratley of Montreal, informed the Quebec Engineering Institute at a conference recently. It will be two miles in length with St. Helen's Island as the central portion.

Washington Notes

A FAVORABLE report has been submitted to the House by the Committee on Irrigation and Reclamation on the bill authorizing the Secretary of the Interior to negotiate with irrigation districts for release from the contract which provides for the construction of project works by the federal government. Secretary Work, in a letter to the committee in support of the bill says:

"It is the policy of the department to turn over the operation and management of irrigation projects after construction to irrigation districts or water users associations. A number of the projects have been so turned over and negotiations are now under way looking to the turning over of other projects. In a number of cases contracts are outstanding under which the United States is obligated to do drainage construction work for the benefit of the landowners. After the projects are turned over the Bureau of Reclamation maintains no regular organization, and if construction is continued it is necessary to maintain for this purpose a special organization. For this and other reasons, it seems desirable that where feasible the irrigation districts or associations do the necessary drainage work with their own organizations and at their own expense. It seems to me this arrangement is likely to result in economy and prove more satisfactory in general.

The present bill is designed to authorize the Secretary of the Interior to make suitable arrangements with irrigation districts and associations for amendment of present contracts so that the additional drainage work required may be done by such districts and associations. Naturally, the assent of the districts and associations involved is necessary before outstanding contracts can be amended."

THE city of Seattle on Jan. 22 filed an application for a license with the Federal Power Commission covering its Skagit River development. The application for a license follows on the heels of the action of the committee in authorizing the preliminary permit covering this project. The application for preliminary permit, however, was filed Nov. 3, 1924. In the interim the city has been conducting its engineering studies. It believes enough data now are available to permit of the consideration of the license.

According to the data submitted with the application the Ruby dam will produce a reservoir of 3,500,000 acre-ft. capacity. The head would be 445 ft. and the primary capacity 83,000 hp. It is planned, however, to install at that dam six 54,000-hp. units. The Diablo dam will back up the river to the Ruby dam. Its capacity is calculated 90,000 acre-ft. The head which would be developed at that point is 320 ft. The primary capacity is estimated at 108,000 hp. Six 47,000-hp. units will be installed at that dam. The George dam will create a reservoir holding 6,000 acre-ft. This water is to be used in the existing Gorge power plant. The primary capacity there is 150,000 hp. At present 75,000 hp. are installed. The ultimate installation, however, plans to use eight 37,500-hp. units.

OPPONENTS of the Campbell bill, which provides for a more liberal policy in allowing bids for public works, are convinced that the measure will make no further legislative progress at this session of Congress. The bill was reported favorably from the Judiciary Committee of the House on Dec. 16. The effort to obtain a special rule for the consideration of the bill was unsuccessful and the attempt to consider the measure under suspension of the rules thus far has failed.

At the Corps of Engineers it was stated that there is no objection to the submission of the Corps' estimate of costs whenever bids are asked on a project, but the fear is expressed that the requirement to call for bids on practically all projects would make for waste and delay. The bill would require them to get out specifications even on projects where it is known that no bids would be forthcoming.

Gen. R. C. Marshall, who has been active in getting the legislation on to the House calendar, takes issue with claims that the Campbell bill is not in the interest of the taxpayer. He calls particular attention to the fact that work is to be awarded to private contractors only if it is lower than the estimate of the government agency. The contractors will insist, however, that all costs should be included in that estimate. At present, he declares, the estimates of government agencies do not include many items of cost.

DESPITE rumors to the contrary the President, on Jan. 21, signed the Rivers and Harbors bill. The act carries authorizations totalling $73,000,000. This is the largest program of public works of this type ever provided in a single measure.

No appropriation will be asked for the engineering studies of rivers at this session of Congress. In embarking on a survey for which $7,322,400 is authorized, it is pointed out at the Corps of Engineers, that much careful planning must be done and the procedure worked out. This is expected to take the greater part of a year. The principal projects covered in the bill were noted in *Engineering News-Record*, May 6, 1926, p. 743.

U. of Missouri Plans $250,000 Engineering Hall

An appropriation of $250,000 for an engineering building is included in the budget which the University of Missouri, at Columbia, Mo., will submit to the state legislature this month. With the exception of a small engineering laboratory there has been no extension of the buildings for several years, so that it is hoped the needs will be recognized at this time. With an attendance of about 400 in the college of engineering during 1926 the distribution was as follows: electrical, 40 per cent; civil, 35; mechanical, 20; chemical, 4, and agricultural engineering, 1 per cent.

Obituary

H. PERCY BOULNOIS, at one time city engineer of Liverpool, England, and almost from its inception chairman of the Board of Directors of the St. Bride's Press, publisher of the London *Surveyor*, died in London on Jan. 9 at the age of eighty. After finishing a course at King's College, London, and spending a year on railway construction in France, he was articled to Sir (then Mr.) Joseph Bazalgette, chief engineer to the London Metropolitan Board of Works. At the end of his pupilage in 1870, he became a district engineer in Jamaica. From 1874 to 1883 he was city surveyor of Exeter, England; from 1883 to 1890, borough engineer of Liverpool. Then followed 14 years' service as engineering inspector of the Local Government Board of England, latterly as deputy chief. From 1897 until the outbreak of the European war he practiced as a consulting engineer. In 1883 Mr. Boulnois wrote "The Municipal and Sanitary Engineers' Handbook," a pioneer in the field indicated. He was also author of "Housing of the Working Classes," "Modern Roads" and "Reminiscences of a Municipal Engineer." He was a member of the Institution of Civil Engineers and a past-president of the Municipal and County Engineers and other technical organizations. In the course of a brief appreciation signed "A.J.M." in *The Surveyor* of Jan. 14 these sentences appear: "A municipal engineer to the backbone, he would never give evidence against a local authority [city or town] unless on behalf of another authority. He has enriched the literature of his profession with many notable contributions which, apart from their technical value, have a charm which was all his own." The "Reminiscences" already mentioned were review at length in *Engineering News-Record*, Jan. 20, 1921, p. 128. They showed great breadth of interest and activity on the part of Mr. Boulnois, including excursions in other than technical literature.

ANSON WOOD BURCHARD, vice-chairman of the board of directors and chairman of the executive committee of the General Electric Co. and chairman of the board of directors of the International General Electric Co., died Jan. 22, of acute indigestion at the home of Mortimer L. Schiff, with whom he was lunching, in New York City. Funeral services were held Tuesday morning from his late home, 690 Park Ave., New York. Mr. Burchard was born in Hoosick Falls, N. Y., April 21, 1865. He was graduated from Stevens Institute of Technology in 1885 with the degree of mechanical engineer. In 1902 he joined the organization of the General Electric Co. and until 1904 was comptroller, with headquarters at Schenectady. In 1904 he was named assistant to the president, in 1912 he was elected a vice-president, and in 1917 was elected a member of the board of directors. In May, 1922, he was elected vice-chairman of the board, and in June of the same year was elected president and chairman of the board of directors of the International General Electric Co. About a year ago he was relieved of the duties of president, but continued as chairman of the board. He was director of several utility and electrical companies, and a member of many electrical and power clubs and organizations.

ORIN B. ENT, president of the State Construction Co., Indianapolis, Ind., died recently at his home following a short illness. He was 64 years of age and had been in the contracting business in Indianapolis 35 years, his firm having constructed public schools and other large buildings.

Engineering Societies

Calendar

Annual Meetings

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Quebec, Feb. 15-17, 1927.

ASSOCIATION OF HIGHWAY OFFICIALS OF NORTH ATLANTIC STATES, Trenton, N. J.; Annual Meeting, Atlantic City, N. J., Feb. 16-18, 1927.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual meeting, Chicago, Ill., Feb. 22-24, 1927.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Convention, Chicago, Ill., March 8-10, 1927.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Chicago, Ill., May 9-12, 1927.

The Michigan Engineering Conference will be held Feb. 3 and 4 at the Hotel Statler, Detroit, Mich. Preconference headquarters have been established in the office of the Detroit Engineering Society, 478 West Alexandrine Ave., Detroit. This is the second conference. The first conference was held last year in Detroit, with an attendance of over 900 engineers. Officers in charge are: L. E. Williams, chairman; R. E. Wasmus, treasurer; E. L. Brandt, secretary; H. A. Shuptrine, past chairman.

The Central Ohio Section of the American Society of Civil Engineers at its annual meeting elected the following officers: President, E. G. Bradbury, Franklin County sanitary engineer; vice-presidents, John C. Prior, consulting engineer, Columbus, and Alvan B. Tallmadge, consulting structural engineer, Columbus; and secretary-treasurer, V. A. Eberly, bridge designer, State Highway Department. This section has a membership of about fifty engineers in Columbus and central Ohio. Luncheon meetings will be held monthly during the season.

The San Francisco Bay District Society of Engineers held its annual meeting in San Francisco Jan. 11 and elected the following officers: President, George E. Young; vice-president, John Wallace; secretary, Albert J. Capron; and treasurer, W. J. Rawles. This society is the organization that was formerly a chapter of the American Association of Engineers.

Personal Notes

H. A. NUNLIST, division engineer of Division 8, Ohio Division of Highways and Public Works, with headquarters at Cincinnati, Ohio, has resigned effective March 1, 1927. Mr. Nunlist will become associated with the James A. Stewart Co. of Cincinnati. He will be succeeded by HENRY W. WALSH, whose appointment is a promotion, as he has been serving as assistant division engineer under Mr. Nunlist. Mr. Walsh has been with the department since 1920 and is a graduate of the University of Dayton in civil engineering. He is a native of Greene County and his present residence is at Xenia. His new office will be at Cincinnati.

FRANKLIN DUANE, for the past six years engineer of maintenance-of-way of the Southern General Division of the Pennsylvania R.R., with headquarters at Wilmington, Del., has been made assistant to the general superintendent of this division, still with headquarters at Wilmington. Mr. Duane is a graduate of Princeton University and entered the service of the Pennsylvania R. R. as rodman in 1883 and rose through intermediate positions to that of maintenance-of-way of the Southern General Division. In that work, his successor now is RAYMOND SWENK, formerly in the Baltimore section but recently from Pittsburgh.

JOSEPH D. WOOD, Boise, Idaho, has been appointed commissioner of public works of the state of Idaho, succeeding WILLIAM J. HALL who has held the position since its creation in 1919 but who recently resigned. Mr. Wood has been with the Idaho Bureau of Highways since 1914, for the past eight years as district engineer of the southwestern part of the state with ten counties under his supervision, including two important routes, the Old Oregon trail and the North and South highway. In the position of public works commissioner he will pay especial attention to maintenance problems and to improvement of the present highway system, as well as having charge of building construction for the state's penal institutions.

DR. A. ROHN, rector and professor of structural engineering in the Federal Institute of Technology at Zurich, Switzerland (known generally as the Zurich Polytechnium), has been made president of the institution under appointment by the Swiss Government. Dr. Rohn was the Swiss delegate to the International Engineering Congress held during the San Francisco Exposition and since then has kept up many of his contacts through visits of Americans in Zurich.

G. I. WRIGHT, office engineer, Illinois Central R.R., has been appointed assistant electrical engineer, with headquarters at Chicago.

B. H. MANN, signal engineer of the Missouri Pacific Ry., at St. Louis, Mo., has been appointed consulting signal engineer, and B. H. Gault succeeds him as signal engineer.

Construction Equipment and Materials

A Section Devoted to What the Manufacturer is Doing for the Engineer and Contractor

New Equipment for 1927 at Road Show—II

Exhibits of 305 manufacturers show new models of construction equipment to 25,000 engineers and contractors

This is the second and concluding article in the review of construction equipment exhibited at the Road Show in Chicago Jan. 10-14. The first half appeared in these pages Jan. 20.

Snow-Fighting Equipment

BOTH rotary and V-type snow plows were exhibited. The rotary plow manufactured by the Rotary Plow Co. was shown attached to an FWD truck, being operated by a gear reduction from the crank shaft. The Wausau Iron Works exhibited a large V-type plow, with a spread of 14-ft. which is increased to 22 ft. when the wings are extended. The front end height of this plow is 5 ft. 9 in., and it weighs 8,200 lb. It is built around a Caterpillar "60" tractor. The plow is lifted and moved by means of differential pulleys. The LaPlante-Choate Manufacturing Co. exhibited an hydraulically operated snow plow built around a Caterpillar "60" tractor. The hydraulic equipment was mounted behind the cab while the large plungers for adjusting the plow were supported by means of a cross frame going over the top of the cab. The Baker Manufacturing Co. also exhibited a V-type snow plow with wings and the Northfield Iron Co. featured pressed steel snow fence utilizing steel channel posts.

Street Sweepers and Flushers

A NUMBER of large street sweepers and flushers were exhibited for municipal service. The Elgin Sales Corp. exhibited motor-driven pick-up sweeper upon which some 20 new refinements have been made during the past year. The Austin-Western Road Machinery Co. also exhibited a motor sweeper. A snow and street sweeper built for Fordson tractor operation and a street flusher with a Fordson power plant and designed for Fordson towing were products exhibited by Whitehead & Kales. The White Co. exhibited a motor flusher. A vacuum street sweeper was exhibited by the Butler Manufacturing Co. This is a brush sweeper with a secondary vacuum action that collects the dust which the broom raises. The brush picks up heavy litter as well as dust. The material is brushed onto an endless belt conveyor and carried to a bin near the front end of the truck body.

Engines

FIFTEEN manufacturers of engines had exhibits at the Road Show. Two Diesel engines were exhibited. Fairbanks, Morse & Co., exhibited a large Diesel engine designed for dredge duty. The Foos Gas Engine Co. showed its Type L engine equipped with a radiator and designed especially for use on power shovel locomotives, etc. Northwest Engineering Co. exhibited its Cummins Diesel engine used on its Diesel equipped shovels and cranes. Especially notable in the gasoline engine engine field were the very large pieces of equipment shown, both in 4-cylinder and 6-cylinder sizes and rated over 100 hp. Gasoline engines were exhibited by the Minneapolis Steel & Machinery Co., Fuller & Johnson Mfg. Co., Wisconsin Motor Mfg. Co., Hercules Corp., Continental Motors Corp., Stover Mfg. & Engine Co., Hercules Motors Corp., Universal Motor Co., Buda Co., Climax Engineering Co., Beaver Mfg. Co., Waukesha Motor Co., Le Roi Co. and the Novo Engine Co.

Drag Buckets

AUTOMATIC BUCKETS, largely as a result of the increase in the use of small size cranes, tended during the past year in the new designs to be of ½ cu.yd. capacity or smaller. The Hayward Co. exhibited a new ½-yd. clamshell digging bucket and a new clamshell power wheel rehandling model. This company also developed a new drag scraper. The Owen Bucket Co. exhibited ⅜ and ¾-cu.yd. buckets, the G. H. Williams Co. A ¾-yd. clamshell and a new drag line using a heavy bridge and a cast lip. Browning Crane Co., McMyler Interstate Co., and the Bradley-Badger Engineering Co. also exhibited buckets.

Compressors and Air Equipment

PORTABLE AIR compressors have become standard construction machines. Compressed air is being used more and more on highway work as power for hoists, for operating pumps, for the usual rock-drilling operations. Mechanical drill sharpeners are very important on the larger jobs where drill steels are subject to extended and rough service.

Portable air compressors of a variety of models were shown. Curtis Pneumatic Machinery Co. exhibited a portable compressor designed as a trailer unit for a Fordson and connected to the Fordson power take-off by means of a belt. Metalweld Service Corp. exhibited a portable air compressor consisting of a Fordson tractor with a vertical Worthington compressor mounted on a platform at the rear. This machine was of 110-cu.ft. capacity. This company also exhibited a 210-cu.ft. machine for towing, using a Continental engine for the power unit. Sullivan Machinery Co. exhibited for the first time a 103-ft. electrically driven machine in addition to its angle type machines of 220-cu.ft. and 310-cu.ft. capacities. An air hoist and mechanical drill sharpener were also exhibited. Schramm, Inc. exhibited a new 60-cu.ft., 2-cylinder air compressor direct connected to a 2-cylinder Buda engine with a flexible clutch. Buhl Co., exhibited for the first time a compressor-hoist combination, the hoist being of single-drum type connected through gears and clutch and with a 2,500-lb. pull on a single line.

A complete portable drill steel sharpening plant was exhibited by the Ingersoll-Rand Co. This company distributed its booklet entitled, "One Thousand and One Ways to Make Money," consisting of contractors' hints, and of which over 100,000 copies have been issued since it was first published.

A portable gas engine air compressor, equipped with an air hoist and air pump was also exhibited. Drill steel heating oil furnaces, drills, clay diggers and other pneumatic machinery completed the exhibit. The Chicago Pneumatic Tool Co. exhibited portable compressors, clay diggers, pavement breakers, rock drillers and riveting hammers. Other companies exhibiting portable compressors were the Independent Pneumatic Tool Co., and the Mundie Mfg. Co.

Motor Trucks, Bodies and Body Hoists

MOTOR trucks, especially designed for road building conditions, were the rule rather than the exception at the show. Most of these were equipped with dump bodies, using gravity, mechanical or hydraulic hoists and of one, two or three-batch capacity. The range in size was from small Ford trucks to those having capacities of five tons. Three models of trucks were exhibited by the Hug Co. A new 5-ton model was shown with an hydraulic dump body. The company's trucks featured dual tire adapters in order to increase the wheel bearing area by adding an extra tire. The O'Connell Motor Truck Co. exhibited a truck designed to be driven either frontward or backward, especially useful where long backing is necessary in order to reach the paver on a concrete road job.

A radically new principle of drive was incorporated in a new truck exhibited by the Commerce Motor Truck Co. Unlike the ordinary type of axle where the load is carried by the rear axle directly over the point of contact between the wheel and the road, this truck utilizes a so-called live axle which is suspended from the regular wheel

axle, and free to swing about the axle as a center. The live axle is connected to the rear wheels by a pinion meshing with a circular rack attached to the spokes. Applying power to the live axle causes it to revolve around the circular rack until the center of gravity of the load is ahead of the regular wheel axle; the wheel will then revolve forward and the process will then be repeated. Other companies exhibiting motor trucks were Valley Motor Truck Co., Parker Truck Co., Indiana Truck Corp., General Motors Truck Co., White Co., exhibiting a new 2-batch road builders truck with a 144-in. wheelbase rated at 2½ tons; Four Wheel Drive Auto Co., Garford Truck Co., featuring a new model 1½-ton with 122½-in. wheelbase and 1½-yd. gravity body; International Harvester Co., Autocar Sales & Service Co., showing its new 3-ton chassis with motor under the hood and its older type truck with the motor under the seat; Oshkosh Motor Truck Mfg. Co., showing a four-wheel drive truck; The Republic Truck Sales Corp., exhibiting a 3½-ton truck with a 7-speed transmission, and the International Motor Co., exhibiting a Mack 2½-ton equipped with a 2⅝-cu.yd. body.

A number of special bodies and cabs were exhibited, the most notable of which was the body of the Differential Steel Car Co., which consisted of a dump body, dumping to either side or to the rear. Hughes-Keenan Co. exhibited a gravity dump body, buck seat and hoist. The Superior Body Corp. featured a 1½-yd. dump body for both short wheelbase and long wheelbase trucks. Anthony, Inc., showed a new roller rocker dump body, designed for gravity dump on trucks with extra long frames. Highland Body Mfg. Co. exhibited enclosed cabs, while other dump bodies were shown by the Heil Co. and the Galion All-Steel Body Co. Two companies exhibited hydraulic hoists, The Hydraulic Hoist Mfg. Co. and the Wood Hydraulic Hoist and Body Co. The latter company had a large exhibit featuring its standard hoist and body outfit and also an operating cutaway of a new mechanical hoist which has just been developed.

Tractors and Trailers

FOR ROAD building and road maintenance, the towed machines and notably the graders have increased in size to such an extent that large and heavy tractors have become necessary. The Cleveland Tractor Co. exhibited for the first time, in addition to its regular 20- and 30-hp. crawler tractors, a new 12-ton 75-hp. crawler. The machine is designed to operate road graders, elevated graders, scraper trains, dump wagon trains, etc. The new machine also features a "one-shot" lubrication system. Manganese steel is used in the tracks and drive sprockets. Another heavy duty tractor was exhibited by the Monarch Tractors Corp., featuring a 10-ton model with a chain drive. The Caterpillar Tractor Co. showed 2- and 5-ton standard models and its Thirty and Sixty models. It also exhibited a Thirty model tractor equipped for snow removal work with enclosed cab and electric lights. Electric Wheel Co. also developed during the past year a 21,000-lb. 80-hp. crawler tractor, built on the same general lines as its old 5-ton tractor. This company also exhibited a crawler unit for the McCormick-Deering 10-20 tractor and also a Fordson crawler unit and a Lessman loader, being a shovel attachment placed on the front end of a Fordson. A new model tractor was exhibited by the Full-Crawler Co., in which the track area has been increased to 1600 sq.in. This unit is built around the Fordson power plant. Bates Mfg. Co. exhibited a 3½-ton and 7-ton crawler tractor. Belle City Mfg. Co. showed a Fordson crawler attachment.

In the field of heavy trailers the Freuhauf Trailer Co. showed a large trailer with four rear wheels and a 20-ft. wheel base for transporting such equipment as power shovels, cranes and mixers. A four-wheel reversible trailer with Westinghouse air brakes and rubber tires was exhibited by the Highway Trailer Co. This company also exhibited 3½-yd. side-dump garbage trailer and a large 30-ton trailer for shovels, cranes, etc. All equipment is fitted with roller bearings. The Rex-Watson Corp. exhibited a new 3-yd. all-steel bottom dump trailer, disk type wheels and roller bearings. Brookville Locomotive Co. exhibited an industrial locomotive, built around a Fordson tractor, incorporating as a new development during the past year three equal speeds both forward and reverse. No alteration of the Fordson mechanism is necessary. The Rogers Bros. Corp., manufacturers of heavy duty trailers, also were represented at the show.

Traffic Control Equipment

THAT HIGHWAY operation has taken its place alongside of highway construction and maintenance, was well illustrated at the show by the several exhibits of traffic lights, signs and markers. The Essco Mfg. Co. exhibited a new sign, known as the "Seethru." This sign is designed to be placed so that the rays from a street light behind it can provide the source of light. Other equipment included automatic and manual control devices, warning signals, etc. The American Gas Accumulator Co. exhibited its line of traffic signals and signs. The feature of the latter was a prismatic construction for the wording which collects light from any direction and reflects it directly to the eye. Alumoyd Sign & Signal Co. exhibited street markers and direction signs made of aluminum. National Road Markers featured rubber signs for inlaid pavement markings. National Traffic Appliance Corp. showed metal spots to be driven into the pavement as markers for traffic lanes and safety zones.

EXHIBIT OF CONSTRUCTION EQUIPMENT AT ROAD SHOW, CHICAGO, JAN. 10-14, 1927.

Road painting machines were exhibited by the Continental Products Co. and by Simons Paint Spray Co. The latter used an air spray, while the Continental machine laid the line by means of a belt revolving through the paint. The latter company also exhibited numerous types of paints for street marking, highway fence and bridge work. Welsbach Traffic Signal Co. featured signals and signs operated by a storage battery.

Accessory Equipment

ACCESSORY equipment and fabricating parts in general as used on construction equipment are comprising each year more a part of the total number of exhibits. Contractors like to compare these important details of the machines which they buy since the comparative advantages of one construction machine over another may rest entirely with the type and quality of accessory equipment and fabricating parts that are used in its construction. These items include such products as axles, transmissions, clutches, carbureters, steel castings, radiators, wheels, magnetos, spark plugs, lubricating systems and bearings. Both Hyatt Roller Bearing Co. and Timken Roller Bearing Co. had extensive displays at the Show. Probably over 50 per cent of the construction equipment shown this year was equipped in whole or in part with roller or ball bearings. Brown-Lipe Gear Co., exhibited transmissions and clutches while Price-Hollister Co., exhibited a truck transmission and drive shaft. Timken-Detroit Axle Co., showed both a front axle and rear axle the latter equipped with worm drive for both standard and four-wheel drive trucks. Eaton Axle and Spring Co., also exhibited rear axles. Racine Radiator Co., featured its latest type sectional radiator in addition to its Ford replacement radiators. Gas engine governors were shown by the K. P. Products Co., Inc. Magnetos, spark plugs, and impulse starters were exhibited by the Splitdorf Electrical Co., Eisemann Magneto Corp., A. C. Spark Plug Co., American Bosch Magneto Co., and the Robert Bosch Magneto Co., Inc. The latter company featured a new "No Battery" generator for use on trucks and tractors as a source of light whenever the engine is running. Heavy-duty carbureters were exhibited by the Zenith-Detroit Corp. Tractor-Grip Wheel Co., exhibited a gridiron grip tractor wheel. New wheels for trucks and buses were exhibited by the Erie Malleable Iron Co. A new wheel known as a web-steel wheel was exhibited by Whitehead & Kales. It is an outgrowth of the disk wheel, the spokes being wide and of relatively thin metal. However, reinforcing is used around the hub where the greatest strains occur bringing the total thickness at this point up to ⅛ of an inch. The wheel is especially designed for easy washing and to eliminate the roar often caused by disk wheels. French & Hecht featured wheels of the expansion type on which the tires may be changed without resorting to a press. Expansion wheels were shown for a number of different construction machines and tractors. A special feature was a 50x10-in. rubber tire and demountable steel rim placed over the tractor cleats for use on city streets.

Power take-off units and clutches were exhibited by the Twin Disc Clutch Co. The Bassick Mfg. Co. exhibited the Alemite and the Alemite-Zerk Pressure Lubrication System, while the Carr-Fastener Co. exhibited Dot equipment. The latter company showed a new automatic pressure cup providing an adjustable constant feed and filled by means of its pressure gun. Steel castings were shown by American Malleable Castings Association, Chicago Steel Foundry Co., Kensington Steel Co., Gerlinger Electric Steel Casting Co., Western Crucible Steel Casting Co., Taylor-Wharton Iron & Steel Co., American Manganese Steel Co., Sivyer Steel Casting Co., and the Farrel-Cheek Steel Foundry Co.

Manufacturers and Trade Associations

Calendar

Annual Meetings

HOLLOW BUILDING TILE ASSOCIATION, Chicago; Annual meeting, Chicago, Feb. 10 and 11.

COMMON BRICK MANUFACTURERS ASSOCIATION, Cleveland; Annual meeting, Chicago, Feb. 21-26, 1927.

NATIONAL BATTERY MANUFACTURERS' ASSOCIATION, New York; Annual meeting, Philadelphia, March 11 and 12, 1927.

CONCRETE REINFORCING STEEL INSTITUTE, Chicago; Annual Meeting, White Sulphur Springs, West Va., March 21-23.

HYDRAULIC SOCIETY, New York; Annual meeting Chicago, March 25, 1927.

AMERICAN WELDING SOCIETY, New York; Annual meeting, New York City, April 27-29.

WATERWORKS MANUFACTURERS ASSOCIATION, New York; Annual meeting, Chicago, June 6-10.

Pipe

CLAY, STEEL and cast-iron pipes were exhibited at the Show. The American Castings Co., showed its spiral corrugated cast-iron culvert pipe, together with its lockjoint cast-iron pipe. Clay Products Association featured vitrified clay sewer pipes. Corrugated iron culverts were featured by the Central Alloy Steel Co., showing molybdenum steel culverts, by Klauer Mfg. Co., and by the Armco Culvert & Flume Manufacturers Association. The latter's exhibit comprised a model of an embankment through which a culvert was being jacked into place. Sections of perforated culvert pipe for subdrainage work were also shown, as were automatic drainage gates for flood control. Culverts in diameters from 12 in. to 96 in. were exhibited.

Materials

IN THE field of materials there was exhibited those relating to asphalt paving construction, those relating to concrete paving construction, and those relating to brick construction.

Asphalt products included such items as natural rock asphalt, asphaltic concrete, expansion joints, blocks, lubricants. The Asphalt Association featured in its exhibit the new Hubbard & Field stability testing machine. Kentucky Rock Asphalt Co., Barber Asphalt Co., and the Amiesite Asphalt Co. of America showed samples of their products. The Texas Co. featured sheet asphalt and asphaltic concrete and exhibited a section of a valve from which could be demonstrated the proper method for unloading tank cars. American Tar Products Co. was also an exhibitor. Asphalt blocks were exhibited by the Asphalt Brick Co. and the Hastings Pavement Co. Literature describing large asphalt plants was distributed by the F. D. Cummer & Son Co. Expansion joints were exhibited by W. R. Meadows, Inc., Servicised Products Corp. and the Philip Carey Co. The Philip Carey Co. exhibited for the first time an asphaltic flooring system for highway grade crossings. Servicised Products Corporation had on exhibit two types of expansion joints. A metal edge and channel cap were shown to be used as an aid to proper and rapid installation. Bituminous sewer pipe joints and rail filler were other products shown. Lubricants were exhibited by the Vacuum Oil Co. and the D-A Lubricant Co.

Among the national associations exhibiting were the Portland Cement Association, the National Lime Association and the National Paving Brick Manufacturers Association. In connection with concrete roads, four companies exhibited admixtures for concrete. These were the Celite Products Co., The Dow Chemical Co., The Solvay Process Co., showing flake calcium chloride and The Grasselli Chemical Co. showing silicate of soda. Atlas Lumnite Cement Co. showed photos of the use of its high early strength cement. American Vibrolithic Corp. exhibited literature and samples of its vibrolithic and interlocking pavement. Steel reinforcement in bars and mesh was exhibited by the Concrete Steel Co., Rail Steel Bar Association, American Steel & Wire Co., Truscon Steel Co., National Steel Fabric Co., showing also its new machine for installing the reinforcing, Joseph T. Ryerson & Son, Kalman Steel Co., and Wickwire Spencer Steel Co.

Equipment incidental to highway construction which was shown, included steel paving guards, guard rail cables, and highway fences. In addition to these the Marshall Seed Co. showed samples of its seeds and its method of scientific seeding of highway embankments for beautification and for stopping erosion. W. S. Godwin, Co., Inc., showed steel paving guards. Highway guard rails and fences were shown by MacWhyte Co., The Page Steel & Wire Co., featuring a woven wire fabric, The Cyclone Fence Co., showing a snow fence with wood slats and the Wickwire Spencer Steel Co., featuring a wire rope highway guard.

Small Tools and Equipment

MANY SMALL tools often lost sight of in considering the bigger problems of highway construction, but

necessary in the actual carrying out of any road building or maintenance operation were shown. The Rawls Machine & Mfg. Works, exhibited a highway mower mounted on rubber tires. Alexander Milburn Co. showed welding and cutting torch outfits, portable carbide lights, paint sprays and other equipment. In addition to this a new illuminating-gas cutting torch was shown. Hand shovels and tools were exhibited by the Conneaut Shovel Co., featuring its new heat-treated shovel, The Zenith Shovel Co., featuring a new shovel of light weight and the Ames Shovel & Tool Co. Tapes, rulers and similar products were exhibited by Lufkin Rule Co., while the American Blue Print Co. showed its several models of transits and levels, in addition to its rules and tapes. Wheelbarrows and concrete buggies were shown by the Toledo Wheel Barrow Co. Oil jacks were shown by the Oil Jack Co., patent wrenches were exhibited by the Ajax Wrench Co., and the Snap-On Wrench Co. McKloskey Torch Co. and the Toledo Pressed Steel Co. exhibited special torches with an oil burning wick for use around construction jobs. The Macleod Co. featured several pieces of contractors' small equipment including a surface heater on a two-wheel trailer for asphalt repair work, carbide lights, concrete mixer heaters and two new types of salamanders burning kerosene fuel.

Miscellaneous Equipment

SAW RIGS and wood working machinery were exhibited by the C. H. & E. Mfg. Co., Inc., Hutchinson Mfg. Co., and the Jones Superior Machine Co. The latter's machine has been improved since last year by the installation of roller bearings and special lubrication. The LeRoi Co. exhibited a small engine designed especially for saw table work.

Branding iron, soldering irons and blow torches were exhibited by the Everhot Mfg. Co. Alan Wood, Iron & Steel Co. exhibited a model bridge floor showing its rolled steel traffic tread installed. Wire rope was shown by the Williamsport Wire Rope Co., and A. Leschin & Son Rope Co. Bushings and fittings made up the exhibit of the Bunting Brass & Bronze Co.

Operating models of pile hammers, working under water were shown by McKiernan-Terry Drill Co. Flexible paper lining for cloth sacks used in shipping and handling cement, calcium chloride, etc., was exhibited by the Arkell Paper Bag Co. A tower elevator made up of tubular steel members was a feature of the Dravo Contracting Co.'s exhibit. This company also exhibited a snow plow for tractor attachment. Models for testing machines were shown by Tinius-Olson Testing Machine Co., and the Equipment Corporation of America had an exhibit of its rebuilt equipment consisting of road rollers, hoists, derricks, steam hammers and clam shell buckets. Other exhibitors included the Morris Machine Works showing dredge literature, The Associated Pennsylvania Constructors, The American Wood Preservers Association and the Pittsburgh Testing Laboratory.

Business Side of Construction

Facts and Events that Affect Cost and Volume

This Week's Contracts—Week Ago—Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks. Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial, educational, religious and other buildings. Under the head of excavations are included drainage, irrigation, levee, river and harbor projects.

Money Value of Contracts Let—Entire U. S.

Week Ending	Public Work	Private Work	Total Contracts
Jan. 27, 1927	$17,040,000	$37,175,000	$54,215,000
Jan. 20, 1927	18,672,000	30,042,000	38,714,000
Jan. 28, 1926	12,070,000	26,356,000	38,426,000
Heaviest Week			
1926, Mar. 11	13,029,000	73,613,000	86,642,000
1925, Sept. 3	16,215,000	69,424,000	85,639,000
Jan. 1 to Date			
1927	64,439,000	117,301,000	181,740,000
1926	64,811,000	125,826,000	190,637,000

Money Spent on Engineering Construction in 1926 Very Close to 1925 Totals in 38 States

Contract Value for Each State Together With Per Cent of U. S. Total Shown in Table

THE accompanying illustration shows graphically the standing of each state with relation to volume of construction in 1926 and the year preceding.

Five states are definitely ahead of 1925, while an equal number slumped to an appreciable degree.

The figures tabulated cover heavy engineering construction only, that is, water-works, excavating, drainage, irrigation, river, levee and harbor projects, valued at $15,000 and over; other public works, $25,000; industrial buildings, $40,000; commercial, educational, religious and other buildings, $150,000.

As shown by the map, most of the states closely approximated 1925 in value of contracts let, expressed in percentages of the U. S. total.

States showing the most notable gains were, Maryland, Indiana, Illinois, Michigan and Texas. Recessions were most pronounced in New York, Pennsylvania, Ohio, Missouri and Nebraska.

(See table on p. 177)

CONTRACTS IN 1926 COMPARED WITH YEAR PRECEDING

Value of Engineering Contracts by States and Per Cent Each State Is to Total U. S.

	Value In Dollars	Per Cent of Total U. S. 1925	Value In Dollars	Per Cent of Total U. S. 1926
Maine	$6,264,000	.25	$12,304,000	.42
New Hampshire	5,195,000	.21	5,527,000	.21
Vermont	2,329,000	.09	5,522,000	.21
Massachusetts	132,145,000	5.20	148,761,000	5.22
Rhode Island	18,314,000	.71	19,446,000	.66
Connecticut	35,123,000	1.38	55,035,000	1.92
New England	199,370,000	7.84	246,595,000	8.65
New York	559,946,000	21.28	445,355,000	15.59
New Jersey	54,817,000	2.14	83,126,000	2.90
Pennsylvania	275,620,000	10.80	229,839,000	8.06
Maryland	42,504,000	1.70	95,395,000	3.33
Delaware	2,329,000	.08	2,612,000	.10
Middle Atlantic	935,216,000	36.00	856,327,000	30.00
Virginia	8,833,000	.30	7,741,000	.28
West Virginia	18,048,000	.70	9,938,000	.35
North Carolina	41,817,000	1.60	52,468,000	1.82
South Carolina	5,787,000	.20	3,166,000	.10
Georgia	11,934,000	.50	13,419,000	.45
Florida	59,742,000	2.30	71,902,000	2.52
Alabama	23,600,000	.90	29,807,000	1.05
Mississippi	15,795,000	.70	21,611,000	.77
Louisiana	25,807,000	1.10	31,650,000	1.12
Kentucky	14,377,000	.50	20,029,000	.70
Tennessee	22,226,000	.90	27,197,000	.94
Southern	247,966,000	9.70	288,928,000	10.12
Ohio	154,140,000	6.70	164,734,000	5.78
Indiana	21,431,000	.70	52,318,000	1.82
Illinois	177,532,000	7.00	324,166,000	11.35
Wisconsin	51,783,000	2.00	64,889,000	2.27
Michigan	69,326,000	2.70	118,321,000	4.13
Middle West	474,212,000	19.10	724,428,000	25.37
Minnesota	34,760,000	1.36	31,420,000	1.08
Iowa	22,739,000	.89	35,631,000	1.26
Missouri	138,463,000	5.45	100,366,000	3.50
Arkansas	12,213,000	.48	17,601,000	.63
North Dakota	2,920,000	.11	3,688,000	.14
South Dakota	4,183,000	.16	4,815,000	.17
Nebraska	29,519,000	1.15	16,117,000	.56
Kansas	23,323,000	.92	21,892,000	.77
Oklahoma	35,177,000	1.37	28,507,000	1.01
Texas	91,939,000	3.54	143,593,000	5.04
Montana	1,177,000	.05	2,694,000	.10
Wyoming	1,570,000	.06	925,000	.03
Colorado	8,616,000	.34	7,019,000	.24
New Mexico	959,000	.04	694,000	.01
West of Mississippi	407,558,000	15.92	414,962,000	14.54
Idaho	6,056,000	.23	4,748,000	.17
Utah	405,000	.01	507,000	.01
Arizona	2,207,000	.10	5,791,000	.21
Nevada	1,518,000	.10	2,421,000	.07
Washington	40,175,000	1.50	32,026,000	1.12
Oregon	14,996,000	.50	10,883,000	.38
California	229,764,000	9.00	266,078,000	9.32
Far West	295,121,000	11.44	322,454,000	11.28
United States	$2,559,443,000	100.00	$2,853,694,000	100.00

Record Year in Steel Production —Prices Steady

The steel mills of the country turned out 47,133,517 gross tons of steel ingots in 1926, according to calculations of the American Iron & Steel Institute. This is the heaviest production year on record, exceeding by 6 per cent or more, the previous high mark set in 1925.

The significant part of these production figures is that since reserve stocks of finished steel at mills and warehouses throughout the country are fairly limited, most of this enormous tonnage must have gone directly into use.

Both 1925 and 1926 started off with January ingot tonnages well over the 4,000,000 mark. That returns for January, 1927 may not show as large a volume as in the two years preceding, is suggested by a comparison of monthly tonnages for the last half of each year.

In 1925 the monthly output showed steady seasonal gains from August on up into January, 1926. There has been a steady decline since October, 1926, and the chances are that the first few months of the new year will not find the direction changed.

With such a large quantity of steel available there was little price cutting of consequence, throughout the last year. At the same time, it is worth noting that with a record building demand, there was no appreciable advance in steel quotations during 1926.

The price of reinforcing bars and structural shapes, in carload lots, f.o.b. Pittsburgh mill, was $2 per 100 lb. for the greater part of 1926. Plates sold uniformly at $1.90, on the same basis. Mention of $1.90 per 100 lb. on bars applied mainly to material rolled from rails rather than billets.

Following are the Institute's figures on annual steel ingot production, in gross tons, for the United States, from 1911 to 1926, inclusive:

1911	23,029,479	1919	33,694,795
1912	30,284,682	1920	40,881,392
1913	30,280,130	1921	19,224,084
1914	22,819,784	1922	34,568,418
1915	31,284,212	1923	43,485,665
1916	41,401,917	1924	36,811,157
1917	43,619,200	1925	44,140,738
1918	43,051,022	1926	47,133,517

Lumber Industry Starts New Year With Increased Activity

The principal softwood lumber mills of the country cut less timber in 1926 than in the year preceding, yet at the same time, more material was sold and shipped than in 1925.

The amount of construction proposed in 1926 justifies expectations of as large a volume of work in 1927 as was realized during the record year just closed.

This drop in production, compared with 1925, together with increased orders and shipments, has, in the presence of sustained demand, kept prices on an even keel. No radical fluctuations in lumber prices generally are anticipated in the near future, at least not until the present situation with regard to production, shipments and demand changes materially.

Figures submitted by the National Lumber Manufacturers' Assoc., comparing the lumber movement during the last two years, are as follows:

	Cut Ft.	Shipments, Ft.	Orders, Ft.
1926	13,752,660,914	13,739,693,677	13,490,188,974
1925	13,822,189,997	13,590,302,603	13,203,774,693

Including hardwoods, the grand total for the United States in 1926 was 15,266,935,764 ft., according to the Association.

The first week in 1927 started off with a substantial gain over the last week of 1926, in production and new business. Shipments also moved in greater volume for the country as a whole.

Special Tabulation of Unit Prices

Steel Reinforcing Bars

The following unit prices are included in the low bidders' estimates on various subway jobs, 1924 to date:

Location	Date	Lb.	Price per Lb.
Philadelphia, Pa.	Oct., 1924	1,100,000	$0.045
New York, S. 3A, R. 78	Jan., 1925	640,000	.05
Philadelphia, Pa.	Mar., 1925	2,500,000	.08
New York, S. 1, R. 78	Apr., 1925	620,000	.06
New York, S. 6, R. 78	July, 1925	400,000	.055
New York, S. 1, R. 5	Sept., 1925	700,000	.06
New York, S. 4, R. 102	Oct., 1925	1,200,000	.055
New York, S. 7, R. 78	Nov., 1925	140,000	.0575
New York, S. 8, R. 78	Mar., 1926	170,000	.055
New York, S. 5, R 102	Mar., 1926	570,000	.055
New York, "EE"	July, 1926	76,000	.06
Brooklyn, N. Y., S. 6E1, R. 8	Aug., 1926	200,000	.045
New York, S. 1, R. 102	Sept., 1926	520,000	.0425

The following unit prices are included in the low bidders' estimates on various sewer and sewage disposal projects, 1922 to 1925:

Location	Date	Lb.	Price per Lb.
Marion, O.	Aug., 1922	700,000	$0.037
Ft. Worth, Tex.	Sept., 1922	10,000	.05
Matawan, N. J.	Mar., 1923	5,500	.06
Toledo, O.	Apr., 1923	2,000	.08
Chicago, Ill.	July, 1923	12,500,000	.05
Louisville, Ky.	July, 1923	1,300	.07
Chicago, Ill.	Nov., 1923	600,000	.05
Louisville, Ky.	Nov., 1923	239,400	.062
Stroud, Okla.	Jan., 1924	833	.06
Chicago, Ill.	Mar., 1924	138,000	.055
Philadelphia, Pa.	June, 1924	2,000	.05
Grand Rapids, Mich.	July, 1925	10,000	.05
Chicago, Ill.	Oct., 1925	15,000	.08
Chicago, Ill.	Oct., 1925	22,000	.08

Weekly Construction Market

THE composite price of wholesale commodities as computed by the Government for 1926, shows a decline of over 4 per cent, compared with the 1925 level.

Basic construction materials taken separately, however, show comparatively slight declines compared with 1925.

Lumber, all grades, is down 0.2 per cent; steel, 2.1 per cent; brick, common, 0.6 per cent; and other building materials, 2.2 per cent, taking the average for 1926 as compared with the year preceding.

Price depressions occurring in the current market are largely the results of weather conditions and hand-to-mouth buying.

Rain and floods adversely affect the Southern and Southwestern pine regions. The lumber market is slow all along the Atlantic seaboard from New York to Florida and also throughout the Middle West. Signs of early improvement are noted in the Gulf States.

Other seasonal declines in building materials prices are those reported in brick, No. 1 Douglas fir, white oak, yellow pine flooring and lath, and red cedar shingles. Freezing weather has developed a rising tendency in aggregates at various points.

Window glass quotations rose two months ago, while plate glass held firmly to the then current levels, despite heavy importations at the time. Since then, however, wages have been reduced 10 per cent in the Pennsylvania window-glass factories.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb.	$3.34	$3.80	$4.15	$3.10	$3.35	$3.87½	—$3.00	3.15	$4.00
Structural rivets, 100 lb.	4.20	3.80	4.75	3.50	3.75	4.65	5.00	4.00	5.50
Reinforcing bars, ¾ in. up, 100 lb.	3.24	2.80	3.25	2.30@2.50	2.87½	3.87½	2.95	3.10	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	48%	54%	54%	51%	54.25%	41%	42@53.8%	45%	37.83
Cast-iron pipe, 6 in. and over, ton	48.60	42.75	56.00	46.20	53.00	64.00	48.00	55.00	55.00
Concreting Material									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.10	2.22	2.85	2.31	2.65	1.15
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	1.85	1.65	1.90	1.80	1.25	1.50
Sand, cu.yd.	1.00	1.60	2.00	1.65	1.25	1.00	1.40	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.94	2.50	2.83	1.87½	1.75	2.50	1.70	3.00	2.00
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	62@63	34.00	56.00	40.00	39.25	34.75	27.00	25.00	50.00
Lime, finishing, hydrated, ton	18.20	23.50	19.00	20.00	25.50	24.00	25.50	24.00	21.00
Lime, common, lump, per bbl.	2.10@3.00	1.50	1.82	1.50	1.70	2.70	1.60	2.80	10.00
Common brick, delivered, 1,000	20.40@22.40	10.50	14.10	12.00	13.75	9@10	15.00	15.00	20.25
Hollow building tile, 4x12x12, per block	Not used	0895	.112	.076	.076	.075	.....	09	.10
Hollow partition tile 4x12x12, per block	.1027	.0895	.112	.076	.076	.075	108	.09	.08
Linseed oil, raw, 5 bbl. lots, per 7½-lb. gal.	+.84¾	.90¾	1.10	.84	+.96	1.07	—.91	1.12	1.05
Common Labor									
Common labor, union, hour	.90⅝	.30		.90	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	30@.50	.....	45@.60	40@.45	.50	.....	.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent. L.c.l. is less than carload lots.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Reinforcing bars (billet steel) and shapes delivered to job in less-than-carload lots.

Labor — Cement and concrete laborers' rate, $1.06¼; building laborers, 90⅝c.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone f.o.b.; price on fir is quoted instead of pine. Reinforcing bars (billet steel) f.o.b. warehouse in carload lots; shapes, less-than-carload lots.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. Bars (billet steel) at warehouse in carload lots; shapes, less-than-carload lots.

This limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Jan. 6 the next on Feb. 3.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net. Bars (billet steel) and shapes, l.c.l.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net. Bars (billet steel) f.o.b. in carload lots; shapes, l.c.l.

Dallas quotes lime per 180-lb. bbl. Cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. Bars (billet steel) and shapes, l.c.l.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C.-I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common. Bars (billet steel) f.o.b. in carload lots; shapes, l.c.l.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers. Bars (billet steel) and shapes, less-than-carload lots.

Montreal quotes on fir lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand gravel, lime and cement on siding; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.84). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½ in., $37.83. Bars (billet steel) and shapes, less-than-carload lots.

Unit Prices

For actual prices bid on materials in place at various construction jobs throughout the country, see p. 62 of this issue, following Construction News.

On Jan. 1, 1927

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For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month